RAILROAD GAZETTE

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The Standard Code on the Chicago & North Western.

The Standard Code of train rules has been adopted by the Chicago & North Western, and the new rules went into effect April 6. We note the principal features in which the code varies from the Standard, as issued by the American Railway Association.

The "General Rules" have four paragraphs not found in the standard; one of these refers to employment of minors, and one to assignment of wages. In the definitions that for a fixed signal is omitted. Watches are examined quarterly, and are also inspected weekly, the inspector making an entry on the back of the employee's card each week. A new card is issued each quarter.

Rule 3b reads "Conductors, enginemen, yardmasters and yard-foremen who have not access to a standard clock will obtain correct time from the train-despatcher daily, before commencing their work." Rule 5a reads "Full-faced type will be used at the ends of double-track, at junctions and at terminal stations, where the difference in time of trains is 30 minutes or less." Rule 6 has a number of signs, nearly all different from those of the standard. Rule 7 cautions trainmen to be careful to avoid taking a wrong signal when two or more trains are passing each other in a yard.

In rule 10 green means "proceed"; green and red, proceed with caution. A green and red flag is used to place at the side of the track where trains must run under control. Rule 11 provides for red fuses, but not for any other color. Rule 14d reads "West or north"; e. "east or south." The whistle signal for highways applies to overhead as well as grade crossings.

Rule 16a reads "One continuous whistle when brakes stick or wheels slide." Rule 16 does not provide any signal for starting a train, nor for backing. Rule 20 provides for green signals in the usual manner, although in Rules 8 and 10 green means proceed.

Rule 31b requires extra trains to sound the station-approach whistle when approaching curves. Watchmen at public crossings use green signals. Rule 81a reads: "At meeting points, extra trains, as regards each other, are superior in the direction in which regular trains are superior." Rule 83 has added this sentence: "This information will be furnished the engineman by the conductor upon a regular blank provided for that purpose." Rule 86 reads "An inferior train must clear the time of a superior train in the same direction at least ten minutes"; and this clause is omitted from rule 89. Rule 88 provides a clearance of five minutes. In this, and the other meeting rules, an inferior train is forbidden to run past the switch and back in except when authorized by train order to do so.

Rule 88a gives the yard-limit rule; the limit board does not protect against regular trains. Rule 90a reads "When trains meet by special order or time-table regulations, conductors and enginemen must inform each other what train they are. This must be done by word of mouth." In rule 91 the interval is ten minutes. Rule 95a forbids the running of freights or empty engines as a following section of a passenger train. Rule 97 has four supplementary paragraphs. Rule 98a limits the speed of passenger trains over interlocking switches to 25 miles an hour, and of freights to 15.

Rule 98b reads, in part, "No freight train must pass an open telegraph office not controlled by telegraph block system, except as provided by division time-tables, whether or not train order signal be displayed, until the conductor and engineman have received orders from the train despatcher or a release or clearance, as the case may require, from the operator. Conductors and enginemen of passenger trains will observe the same rule at such telegraph offices as are regular stops for their train. Extra trains will observe the same rule as freight trains, but extra passenger trains are not required to make stops solely for this purpose. They will be governed in this respect the same as regular passenger trains. This does not relieve operators from promptly displaying red signals whenever they have orders, or making other necessary efforts to stop trains."

All freight and extra trains must approach and pass all stations, side tracks and water tanks, under control; getting the speed under control must be begun one mile from such points.

Rule 99 and three supplementary rules fill nearly two pages. This rule requires the use of fusees at night in all cases. The first line of this rule begins "In case of stoppage between stations."

Rule 102a requires a flagman at all crossings when switching is being done; and 102b forbids the movement of cars in front of passenger stations or over highway crossings, detached from the engine. Cars containing passengers must not be moved unless coupled to an engine, and air-brakes in use.

Rule 104a reads "Where a distant signal is installed for the protection of a switch, and the signal cannot be seen from the switch, the signal must first be set at danger, and then sufficient time, not less than one minute, allowed for train to pass from the signal within sight of the switch before a train or engine shall leave the side track. Extra precautions must be taken in stormy or foggy weather.

Rule 104b requires an engineman, having backed into a siding, to see that the switch is set straight.

Rule 105 regulates the approach of trains to passenger stations where two trains approach at the same time; rule 106 regulates the carrying of passengers on freight trains. The final rule of this chapter, requiring that, in case of doubt, no risk shall be taken, is 114; and this rule (without the number) is printed at the head of each of the chapters for different classes of employees, in the back part of the book.

Rule 206 requires conductors' names to be written in orders, and train numbers of regular trains are written in words and figures. Time, in the body of the order, must be written in words and figures; the figures must not be surrounded by brackets, circles or other characters. There is no provision for the use of "19" orders.

Rule 208a requires meeting orders to be sent to the operator at the meeting point, if practicable. All train orders must have the suffix "12"; to be responded to by "13." If an operator is required to make additional copies of an order he must repeat those copies, the same as the original order.

Rule 210 provides that an operator must give the X response the first thing after receiving an order, and then repeat it. There is no provision for the use of the term "complete"; O. K. takes the place of this. The engineman must read his copy aloud to the conductor before proceeding. An operator at a meeting point, receiving an order, as required in rule 208a, must deliver two copies of it to the conductor first arriving, and the conductor must sign for them. Train order signals stand normally in the all-clear position, except when used to keep trains a required distance apart. A train must not leave a terminal without a clearance, release or train order.

In the blank for "31" orders, provision is made for inserting, as the first line in the order, the time when the last preceding train left.

Following the page on which form 31 is shown, are five other forms; a cross-over permit, a caution card, a clearance, a release from the train order signal, and a release from the train order and block signal. A note on the last mentioned says that when a block signal is in the diagonal position it only indicates that the block is clear to the first switch reached at the next block station.

The telegraph block signal rules begin with No. 300, as in the Standard Code, but the different subjects are not put in the order in which they appear in the standard, so that there is little or no correspondence in the numbers of the rules. The procedure for blocking trains is in principle about the same as in the Standard Code (rules 317 and 318), but the phraseology and the abbreviations are different. Among the definitions is one of the "positive block" and one of the "permissive block." The definition of the distant signal tells what the signal does. The rules for automatic block signals say that a train stopped by a block signal may proceed after waiting one minute, running cautiously to the next clear signal.

Under the head of interlocking there are definitions of the "high signal," meaning one 20 ft. or more above the track, and of a "mast." A dwarf signal is a low *home* signal. The indication for a diverging movement to a side track is given by a dwarf signal either at the foot of the high home signal or (if the high signal is at the left of the track) opposite to it. The light on the dwarf signal corresponding to the stop indication is covered with a shield.

Following the rules for interlocking signals are about 50 pages containing rules for the different classes of employees. The first chapter is for the telegraph department, the rules beginning with No. 700; then come those for agents, for the passenger service, for the freight service, for enginemen and firemen; miscellaneous; air-brakes; the track department and the bridge department. Among the rules for passenger trainmen is one requiring them, after departure from a station, to see whether or not there are any passengers clinging to the handrail of the vestibule. In the miscellaneous rules it is forbidden to allow outsiders to ride cars or assist in switching. No person, either in discharge of duty or otherwise, shall ride on the pilot of a locomotive. In the air-brake rules there is one requiring brakes to be tested ("the two-mile test") on approaching a terminal, a meeting point, a railroad crossing or a heavy descending grade. The conductor's valve may be used to apply the brakes on passenger trains, but it must not be used except in cases of emergency.

Automatic Block Signals on the Philadelphia and New York Divisions of the Pennsylvania Railroad.

WITH AN INSET.

The Pennsylvania Railroad Company now has its road equipped with automatic track-circuit block signals practically all the way from Jersey City, N. J., to Paoli, Pa., about 104 miles, and the line is four-track for substantially the whole of this distance, thus making what is probably the most elaborate railroad plant, for so long a distance, in the world; for the block sections are all less than one mile long, and, in addition to the block signaling, the stations and yards are nearly all equipped with complete interlocking. Switches which are not connected with a cabin, and interlocked, are equipped with electrical connections, so as to short-circuit the current of the track battery whenever the switch is not set straight for the main line, thus setting at "stop" the signals controlling the entrance to the block section in which the switch is located. The signals (semaphores) stand normally in the clear position, that being the standard practice of the Pennsylvania Railroad. Each signal goes to the horizontal position immediately after the locomotive passes it. All of the block signals are the Westinghouse electro-pneumatic.

Eighty-seven miles of the line here referred to consists of the main line of the New York Division, some of which has been automatically signaled for about ten years. It is now thus signaled throughout. The line has four tracks except at the Schuylkill River and a short distance west thereof; at New Brunswick, about one mile, and at Newark for a short distance. Through New Brunswick and through Newark the line will soon be rebuilt at higher levels and with four tracks.

Philadelphia Division.—The remainder of the 104 miles is from Philadelphia westward to Paoli, 17 miles, on the Philadelphia Division. The block signaling on this portion of the line is one of the most recent installations of electro-pneumatic signaling that has been made, and it is this that we shall here describe. This plant has a number of features which were introduced here for the first time.

The line is four-track throughout, and the signals are on steel bracket posts at the side of the road. The power is compressed air, as on the New York Division, but the electric current is supplied by a storage battery at each post, the batteries being charged from a dynamo situated at Radnor, 13 miles from Philadelphia. At this point there is a power house which contains the air-compressors and the dynamos. The storage batteries supply current for the track circuits as well as for the signal instruments.

The drawing on the inset, Fig. 1, shows the general arrangement of the tracks and signals. Beginning at the lower right hand corner of Fig. 1 (see letter P at right of sheet) the terminal station is Broad street, Philadelphia. From this point westward to Powelton avenue numerous changes in the line will soon be made, in connection with the new junction station which is to be built near 32nd and Market streets. The dotted lines, near mile-post 2, represent the New York Division tracks, which run beneath the westbound main track at this point. In stating the distance from Jersey City to Paoli we have omitted that portion of the line from Broad street to this point. At 52nd street (Schuylkill Division Junction, mile-post 4) extensive changes are also being made. The westbound main passenger track, beginning near the arrow shown in the drawing, is to be elevated above the freight tracks and run around the north side of the freight yard, rejoining the present line at O B tower. After the change is made, the eastbound Schuylkill Valley track, which runs into the eastbound main track, will be carried beneath all of the east-and-west tracks.

Bracket posts are adopted for this line, in place of bridges, because the stations are so near together, and for the purpose of locating the signals, in every case, so that they will be in the most suitable position for starting signals at the stations. It will be observed that, at any station, a train headed in either direction has a signal not far in front of it; and, of course, with this arrangement, a train standing at a station is always a considerable distance in advance of the home signal which protects it at the rear. In thus providing for station stops it was impossible, without making the block sections shorter than was required, to have eastbound and westbound signals always at the same point, so that if bridges were to be used each bridge would, as a rule, carry only two signals, a needlessly expensive arrangement.

The block sections are all very short. Those on the

westbound track, beginning at O B tower, are of the following length in feet (read down):

2,195	1,946	2,182
2,330	3,983	2,792
2,377	2,773	2,732
2,562	2,920	2,641
2,561	3,378	2,768
2,672	3,387	2,816
2,691	3,371	2,801
3,021	3,307	2,782
3,109	2,702	
2,106	2,376	

Those on the eastbound track, beginning at P A tower, Paoli, are as follows:

2,520	2,432	3,191
3,100	2,744	3,186
3,677	2,779	3,040
3,677	2,780	3,287
3,208	2,643	3,331
3,230	2,813	3,367
3,640	2,814	2,718
2,442	2,820	2,164
2,420	2,736	

The longest section is that on the westbound track near mile-post 10 (3,983 ft.) At this point the grade, westbound, is descending, whereas in general the westbound grade is ascending all the way from Powelton avenue to Paoli.

The bracket post with its foundation, and the iron box at the base, for the battery and relays, is shown in Fig. 2. The appearance of this post is shown in the photographs, Figs. 3 and 4. The foundation is concrete, iron bolts 1½ in. in diameter running down through from the foot of the post to the bottom of the foundation. A box, made of wood, is fixed at the side of each foundation, and there is imbedded in the concrete a suitable piece of wood, at each side, to which the box is fastened. The foundation is 4 ft. x 4 ft. 6 in. at the top, 5 ft. x 5 ft. 6 in. at the bottom, and 5 ft. deep. An iron plate, held by the four bolts, is fixed at the bottom. The air-pipe and the electric wires are carried to the signal instrument through terra cotta tubes, as shown.

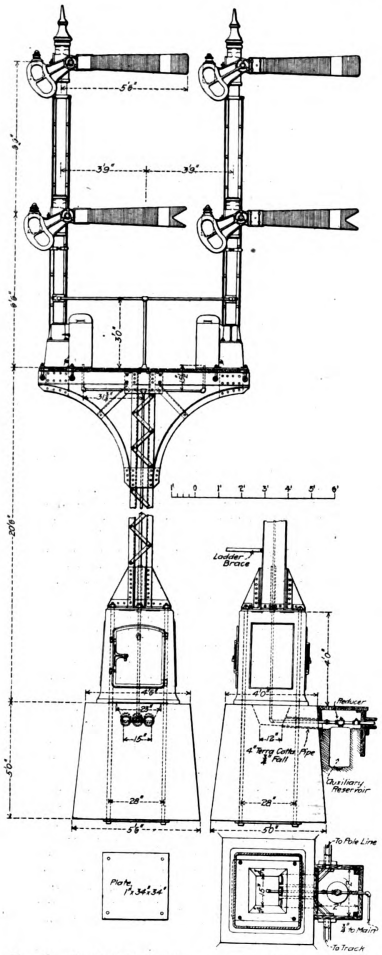

Fig. 2.—Bracket-Post Signal—Pennsylvania Railroad, Philadelphia Division.

The main air-pipe is laid in the ground between the two inner tracks. The feed wire for the batteries (copper, No. 6,) with weather-proof insulation, is carried on poles.

The power-house at Radnor is of brick, 25 ft. 6 in. x 73 ft. 10½ in., and the interior is lined with white enameled brick to a height of about 12 ft. The power is furnished by two 125 h.p. boilers of the locomotive type. The two air compressors are Ingersoll-Sergeant Duplex steam driven, class H, with compound air cylinders and inter-cooler in base. The cylinder dimensions are, steam 12 in. diam., 12 in. stroke; low air pressure, 18 in. diam.; high air pressure, 12 in. diam.; both air cylinders have 12 in. stroke.

The electric current is supplied by two 500 volt Westinghouse shunt wound D. C. generators, 5¾ K.W. These are driven by 12½ h.p. Westinghouse "Junior" engines, directly connected.

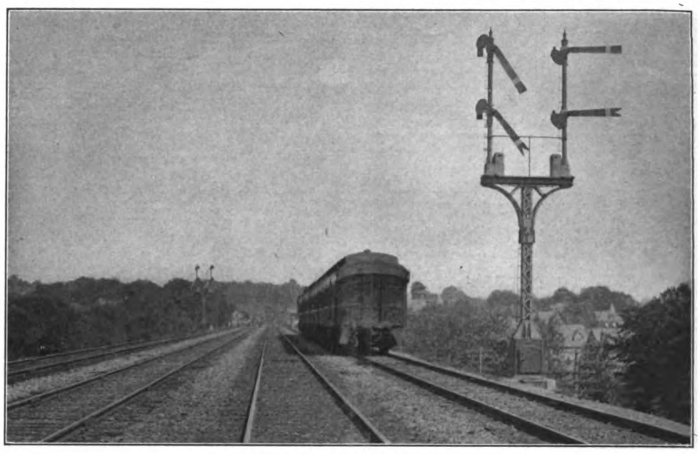

Fig. 3.—Signal Number Nineteen.

The chief duty of this power house is to pump water for the track tanks situated at this point; and the portion of the service required for supplying the signals with air and electric current is an almost inappreciable percentage of the total. The compressors run "turn about" as circumstances may require, and they are automatic, i.e., they vary the speed automatically as the demand for air increases or diminishes. The storage batteries can be charged in 10 hours, sufficiently to provide all needed current for 24 hours.

The storage battery at each post consists of two cells. One of these alone furnishes more than enough current for 24 hours.

Fig. 5 shows one side of the iron case at the base of the signal post, the half containing the relays, connections, and switches. The partition between this half and the other appears as the back of the enclosure shown in this figure. The other side, containing the battery, is shown in Fig. 6.

The interlocking (mechanical) for the switches and signals at the principal stations on this section of the road had been installed long before the automatic signals were put up. The signals at these interlockings are on bridges spanning the tracks, and each signal stands immediately over the track which it governs, as is indicated in the drawing. These signals have been made "semi-automatic" by attaching a pneumatic air cylinder to each main line high-speed semaphore and introducing a track circuit with the usual relay; the controlling wires run to circuit breakers on the different switch and signal levers in the cabin. The leverman is thus enabled to "clear" the signal, when the track is clear, and the train in passing puts it to "danger."

New York Division.—Fig. 7 shows two typical sections of the signaling on the New York Division. In general features the signaling of this and the Philadelphia Divisions is alike. Each block section is worked by a single track circuit, usually 3,000 ft. to 4,000 ft. long, with a home and a distant signal at the entrance of each section, the distant being for the section beyond.

As the drawing which shows the whole of the 90 miles of the New York Division is too large a sheet for reproduction here, even were the scale made very small, we have taken for illustration two typical sections; one of the oldest, from near Philadelphia to Holmesburg Junction, nine miles, and the newest section, from Monmouth Junction eastward to Stelton, 12 miles. Fig. 8 gives a typical view on the New York Division. The bridge shown is No. 436, east of Bristol, and the observer is looking east.

The New York Division, as before stated, is a four-track line, except at Newark, New Brunswick and the Schuylkill River. There are no grade crossings over other railroads, those formerly existing at Elizabeth and North Penn Junction having been changed to undergrade crossings. The principal terminal station is at Jersey City. The important junctions are at Meadows, Newark, Rahway, Monmouth Junction, Trenton, Morrisville, Frankford Junction and Germantown Junction. The junction at Morrisville is arranged to avoid crossing the passenger tracks at grade by bringing in the Trenton cut-off, across and above the passenger tracks and then down to a grade connection with the freight tracks.

Two of the four tracks are used for passenger traffic and two for freight. This rule is not an arbitrary one, and passenger trains are moved on freight tracks and vice versa whenever necessary to facilitate the traffic, based on the theory that the more elastic the method of operation, the better the results. The passenger tracks are shown in heavy lines on the diagram, and the freight tracks by light lines. By using the outside tracks for passenger traffic, with subways at all important stations, all necessity for crossing the tracks by passengers is avoided, making it possible for two or more trains to pass through a station without danger to the passengers of a train at the station unloading and loading. Between Newark and Jersey City the two south tracks are used for passenger service and the two north for freight, there being no stations between these two cities, and for the reason that the large freight yard at the Meadows is on the north side of the tracks. The passenger tracks are laid with 100 lb. rails and stone ballast; the freight tracks mostly with 85 lb. rails.

Forming as it does one of the two passenger lines between the cities of New York and Philadelphia, the traffic is very heavy, there being 81 through passenger trains, with a large suburban and freight movement. When the four tracks through Newark and New Brunswick are finished, with the elimination of the grade crossings in these cities, it will be no longer necessary to restrict the speed at any point. It will then be a matter of no great difficulty to run trains regularly from Philadelphia to Jersey City in 90 minutes; and with an all-rail connection to Manhattan, beneath the Hudson River, it will be possible to substitute "New York" for "Jersey City" in this statement.

The signaling of this line has been worked out very carefully. The interlocking system comprises 36 plants of the Saxby & Farmer improved mechanical or manual type and four Westinghouse electro-pneumatic power plants, with a number of other power plants under construction. In the 36 manual plants there are 803 levers; and in the four power plants there are 131; a total of 934. These levers operate 553 switches, 515 facing-point locks and 471 signals. Three of the power plants are at the Jersey City Terminal. This terminal is a model one. There are 12 station tracks covered by a single span train shed 250 ft. wide and 770 ft. long; separate platforms for baggage, with elevators dropping to the street level, convenient waiting rooms, a restaurant and a large office building. The signals are uniformly

Fig. 4.—Signal Number Sixteen.

located to the right of the current of traffic and either next to or exactly over the tracks they govern. Two hundred and fifty schedule trains a day are handled with great regularity.

As before stated the signals are operated on the normal safety method. The compressed air for moving the signals is supplied from a 2-in. main pipe extending the entire length of the line, a remarkable example of long-distance air transmission.

The air compressors are located at various water and coal stations as follows:

Location.	Miles from Jersey City.	Continuous Use.	Reserve.
J. C. Elec. Light'g Station	0	..	1
Waldo Ave. Roundhouse	1	2	..
Meadows Coal Station	4	1	..
Rahway Water Station	18	..	2
Millstone Junction Water Sta.	31	1	..
Monmouth Junction Water Sta.	40	..	1
Trenton Water Station	56	2	..
Bristol Water Station	66	..	1
Holmesburg Junction Water Sta.	76	2	..
Mantua Water Station	87	..	1
		8	6

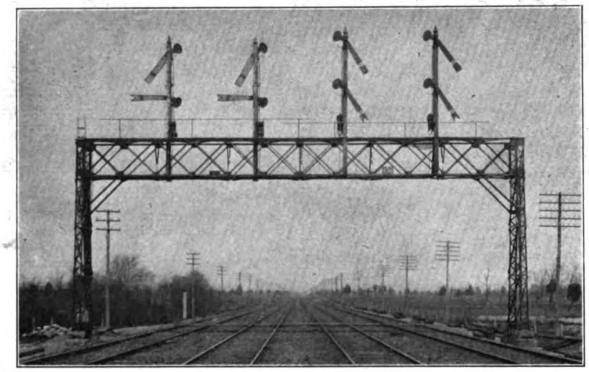

Fig. 8.—New York Division Pennsylvania Railroad, Near Bristol, Looking East; Signal Bridge No. 436.

The compressors in continuous service average about 11 miles apart. Half the compressors were furnished by the Ingersoll-Sergeant Company.

The polarized or wireless system of control, not requiring the use of line wires, is in use on about 20 miles. The balance is worked by the usual wires, all wires being run underground. The wisdom of this method of construction was strongly illustrated during one of the severe storms experienced this winter, which crippled the telephone and telegraph service throughout the East on account of the breakdown of the wires by sleet and high winds. The efficiency of the signal system was not impaired and it continued in regular operation during the entire period of the storm, something not possible if the usual overhead line wire construction had been employed.

The number of signals in use on the New York Division is 1,856, as follows:

Westinghouse automatic electro-pneumatic home and distant signals	1,229
Telegraph block signals (on branches)	76
Interlocking signals, manual and power	471
Distant switch signals	30
Drawbridge signals	20
Flag-station signals	30
Total	1,856

The force required to maintain these signals is as follows:

Repairmen, days, 24; nights, 8	32
Batterymen and helpers	29
Division foremen	4
Interlocking and block signal lampmen	62
	127

This does not include the office and store-house forces or the extra force for construction work. The Division is divided into four sections, each in charge of a foreman, who is responsible for all signals on his section. The foremen report to a Supervisor of Signals located at Jersey City. The first Supervisor of Signals on the New York Division was H. M. Sperry, who resigned in 1891 to enter the signal business. He was followed by Messrs. G. H. Holsman and Geo. W. Miller; and the present Supervisor is Mr. J. E. Gillmor. All material used by the Signal Department is received at the store-house at Trenton, where it is carefully inspected before being issued for use. The Amboy and Belvidere Divisions also receive their supplies through this store-house. An incidental bit of evidence showing the care exercised in the maintenance of the system, is to be found in the pressure recording gages which are located at convenient points for recording the pressure maintained in the main air-pipe. The signal blades are painted and varnished at the store-house at Trenton, a duplicate set being furnished for this purpose and distributed twice a year. They are kept bright during the six months by simply washing them off.

At the three power plants at Jersey City electric lights are used in the lamps. At other places the lamps burn oil, the oil being stored along the line in cast-iron tanks, thus avoiding small oil-houses which are not only unsightly, but dangerous.

Train Movement.—With this complete system of block signaling and interlocking, it is possible to handle trains by signals and almost wholly eliminate the use of train orders. The rule on this point reads as follows: "The movement of all trains will be governed by the signals at the following interlocking stations without train orders, except when running opposite tracks, when they must obtain train orders in every case." Here follows a list of 23 interlocking points, covering all the principal junctions and switches on the New York Division. "Trains on freight tracks receiving signals to enter passenger tracks, except opposite tracks, will proceed as schedule trains. Trains on passenger tracks receiving signals to enter freight tracks, except opposite tracks, will proceed on freight tracks until signal is given to return to passenger tracks." This method of operating greatly facilitates the movement of trains. For example, should a through eastbound passenger train overtake a local passenger train at H U Tower, 26 miles from Jersey City, the despatcher would simply direct the operator at H U to move the passenger train from track No. 1 (passenger track) to track No. 2 (freight track) which he would do by setting the proper cross-over and signals; the through train, without stopping, would then run from No. 1 to No. 2, the local continuing, in the meantime, on No. 1 and stopping at the various stations; the through train on passing the local train would then be brought out again on track No. 1 at D X Tower, Milepost 20, thus having overtaken and passed the local train without stopping and without the issue of any orders whatever, the signals directing the movements and the interlocking and block system providing full protection for both trains at every step of the journey. This method of handling the trains reduces the work of the despatcher to a minimum, enabling him to make movements of one train past the other with little or no delay and by means of the block system and interlocking with full protection for each movement. This feature also was fully tested during the storm of last winter. For a period of 30 hours trains ran absolutely under the direction of the signal system, as there was not a telegraph line in commission during that time between Jersey City and Philadelphia. In fact, the entire operation of trains had to be left to the automatic block signals and to the operators at the interlocking towers.

As a matter of convenience, at points where telegraph stations are some distance apart, telephones have been established at the signal bridges, there being 100 in use between Newark and Philadelphia. These telephones connect with the nearest interlocking towers, and they are indicated on the diagrams by the letter "T." Conductors, enginemen, signal and patrolmen are provided with keys to the telephone boxes, thus making it possible to send prompt reports of any unusual occurrences. They are found to be a great convenience.

A bit of evidence as to what can be accomplished on this line, is shown in a record made on Monday, March 24th, 1902. On that day, at short notice, a special train, engine and two cars, carrying the president of the road, was run from Broad street, Philadelphia, to Jersey City, 89.76 miles, in 1 hour 19 minutes (12:19 p.m. to 1:38), at the rate of 68.17 miles an hour. This is one of the fastest long distance runs on record. The regular traffic, which, as previously stated, is very heavy, is handled with a marked degree of safety and regularity.

A six-track railroad.—The line from Philadelphia to Holmesburg is of special interest because, for nearly all of the way, this section is a five-track or a six-track railroad. These outside tracks have been built from time to time to accommodate the very numerous factories of various kinds which line the railroad in this region. These outside tracks, being used entirely by slow-moving local freight trains, running on rather irregular schedules, are not signaled.

This method of protecting from delays the fast trains on the high-speed tracks is, of course, a costly one; but it has been found necessary. Indeed, it is the only way to insure speed and regularity where the number of passenger trains is so great as on this road; and, with the increase of both the fast passenger traffic, and the local freight traffic to and from the factories, the need of keeping switching movements entirely clear of the high-speed tracks becomes an important factor in safety as well as in convenience.

The principal difficulty in providing, in this way, for local freight traffic is in getting the switching freights past the passenger stations. The only perfectly satisfactory method of dealing with this question is to put the passenger station above or below the level of the tracks; but in many cases this is, of course, impracticable, except at very great cost. And where the natural surface of the ground is at the track level, and the local passenger traffic can be confined to the outside tracks, a station which is above or below the track level has the further disadvantage of necessitating much additional climbing for the passengers.

With stations at the track level the only thing to do with an outside freight track is to break it off before reaching the station, or to run it between the station and the passenger tracks, the platform being laid even with the tops of the rails. Which of these solutions shall prove most feasible in any particular case depends, of course, largely on the nearness of the factory or switching point, and the number of freight movements to be made daily.

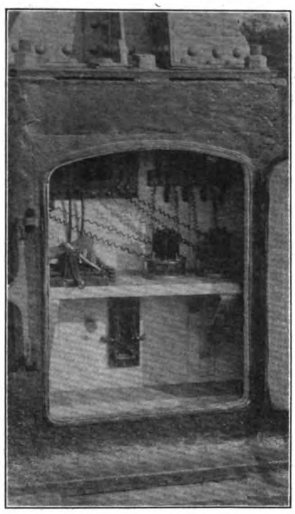

Fig. 5.—Relays and Switches.

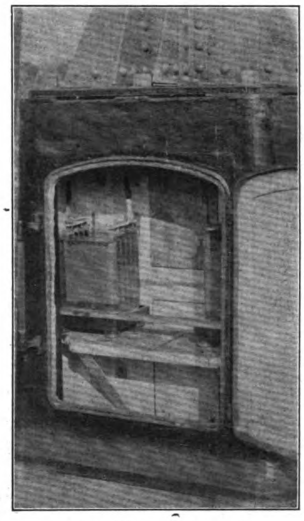

Fig. 6.—Storage Battery.

Standard Train Order Form E.

A paper on form E Time Orders, which was read before the Richmond Railroad Club, at the April meeting, by Mr. E. P. Goodwin, was published in the *Railroad Gazette* April 18, page 283. From the report of the discussion, which appears in the Proceedings, now at hand, it seems that the question concerning the merits of this form was brought up by reason of the fact that some of the railroads in Virginia forbid the use of the Time Order (Example 2), directing a train to wait at a certain point until a certain time, for a specified opposing train. It is said that if such an order requires a train to wait at one or two stations for two trains, and at a third station for