inches a mile, and consequently the change cannot exceed two inches, and will merely reduce the stage of the river a like amount as far up as the foot of the rapid at head of river. The next section is in Lake St. Clair, near the head of Detroit River, and as the excavation of the bed of the lake can produce no change in surface level, no injurious results need be feared. The next reach to be improved, which completes the series, is in Lake Erie, at the mouth of the Detroit River, and, like the preceding, merely amounts to deepening the bed of the lake. The improvement of the Detroit River at the Lime Kiln crossing, which has already been completed, undoubtedly has a tendency to lower the natural slope, but as the length of the improved section is only one-half mile, the change at most cannot amount to one inch.

It is therefore evident that when the proposed improvements are completed the change in the water levels due to the works cannot in any case exceed two inches, which, where the natural fluctuations of the surfaces amount to over four feet, would not be a measurable quantity.

The weak feature of this plan for producing a 20-ft. channel is that the fluctuations of the water surface of Lake Erie are such that there may be several days at a time when vessels of over 16 ft. draft will be unable to pass through. With the class of vessels which will be built for the through traffic when the channel is completed, such a state of affairs will, if possible, be even more unsatisfactory than the present conditions.

From 1865 to 1875 the surface of Lake Erie was considerable of the time from one to two feet below mean lake level, and as a strong westerly wind lowers the water level at the head of the lake from one to three feet it is easy to see that a channel of 20 ft. at mean lake level will by no means insure a navigable channel of anywhere near such depth. The head of Lake Erie is so shallow that to overcome this difficulty by dredging the channel deeper would be very expensive. It may, however, be accomplished by placing a submerged dam across the head of Niagara River of sufficient height to raise the low water level of the lake about two feet. Such a dam would have but little influence on the lake level at time of high stage of water in the lake, and would therefore materially diminish the amount of actual fluctuation of surface.

To thus raise the low water surface of the lake would increase the depth of the entrance channels of the local lake harbors a like amount, and as the improvement of these harbors is likely to cost much more than the main 20-ft. channel in Lake Erie, the saving that may thus be effected may be worth considering.

DETROIT, Jan. 9, 1893.

Hall Automatic Block Signals on the Chicago & Northwestern.

The Hall Signal Company has lately put in a large number of its wire circuit electric block signals on the above named road, and we print herewith a diagram of the circuits as used in those signals. The main principle is the same as that in the simple signal circuit shown in the *Railroad Gazette* of June 13 and Sept. 12, 1890, but there are several additional patents on the arrangement as here shown. The relays and interlocking instruments are placed in the battery houses. The general appearance of the signals is shown in figs. 2 and 3, which are explained by their titles. The small upper opening in the signal case is for the night signal, the lamp being placed back of this instead of behind the main opening, as in the older forms. The arm carrying the disc for the day signal carries at its opposite end a red glass disc which is moved to or away from the small opening in the same way that the cloth disc is moved to or away from the main opening.

In fig. 1 is shown the arrangement of wire circuits used for the operation of the signals. It will be seen that it is necessary for a train to perform two distinct operations to return the signal to clear. This arrangement is to protect a train passing into a section, while a preceding train may have stopped over the clearance instrument, and it also provides for the protection of a train should it overrun the block track instrument. Also, if a train enters a section past a danger signal (after waiting a given time interval according to the rule) and the first train is at the time passing out of the section over the clearance instrument, it will not clear the signal behind the second train.

In the diagram the circuit is as follows: From battery X, wire 1, through magnets and points of block relay E, wire 2, magnets G, and closed spring p, of interlocking relay, block line wire 4, closed track instrument spring a, wire 5, through the magnet of signal instrument, back to battery by wire 6. When the train enters the block section governed by signal No. 1, the first wheels open spring a, of block track instrument A, breaking the signal circuit by demagnetizing block relay E. The

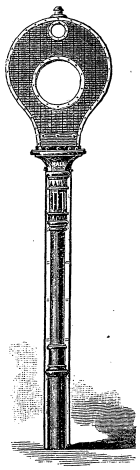

Fig. 2—Home Signal, Showing All Clear.

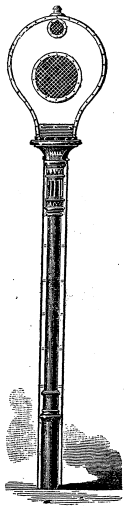

Fig. 3—Distant Signal, Showing Caution.

Hall Automatic Signals.

signal circuit is therefore permanently open, by the opening of points e and e^1.

When the train enters the block section governed by signal No. 3, it opens normally closed spring b, in track instrument B, and puts signal No. 3 to danger, as already described for signal No. 1. It at the same time closes normally open spring b^1, which completes a circuit for a part of battery X, as follows: From battery X, wire 7, through magnets H, of interlocking instrument, mend wire 8, spring b^1, back to battery wire 6. This current, in magnetizing coil H, of interlocking instrument, closes normally open spring o, at the same time opening normally closed spring p, of interlocking instrument.

When a train passes a train length (about 2,000 ft.) beyond signal No. 3 it operates track instrument C, which closes normally open spring c, completing circuit from

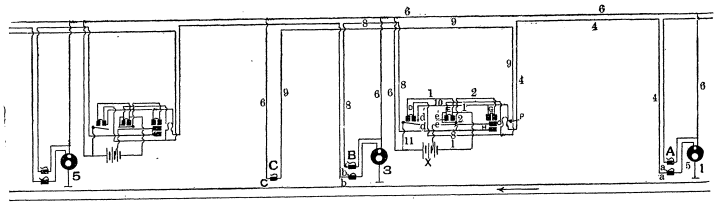

Fig. 1—Electrical Connections for Hall Automatic Block Signals on Chicago & Northwestern Railway.

Fig. 3 shows the form of post used for most of the signals on the Chicago & Northwestern. It is taller than the older pattern, and, as will be seen, presents a more graceful appearance. The case, which makes the background for the disc, is, for distant signals, painted white. Our illustration (fig. 3) is intended to indicate a green disc in a white case, the common style of the Hall Company, but on the Chicago & Northwestern, where the color green is used to indicate "all clear," the disc is different from this. It consists of a green ground crossed diagonally by two white stripes, at right angles to each other, about 1½ in. wide. For the night caution signal the arrangement is the same as in the semaphore signals (shown in the *Railroad Gazette* of May 8, 1891), that is, a green light for all clear and a red and a green side by side for caution.

battery X, wire 1, through magnets of shunt relay D and of block relay E, spring o, of interlocking instrument, clear line wire 9, closed spring of track instrument c, back to battery, energizing relays D and E, thus closing contact between the points of the relays. A local circuit is now set up from Battery X, wire 1, through magnet and points e^1 and e of relay E, wire 2, through magnets G of interlocking instrument, wire 10, through points d^1 and d of shunt relay D, wire 11, back to battery; magnet G is energized, which restores spring o to its normally open and spring p to its normally closed position. With the points of block relay E, spring p of interlocking instrument, and track instrument spring a all closed, the circuit for the signal is again completed, but the signal remains at danger as long as a train is moving over track instrument C, keeping its spindle up. This is owing to the local circuit referred to above, which robs the signal of its battery by means of a shunt. When the train is passed entirely by the clearing track instrument, spring c again opens, magnet D is demagnetized, contact between d^1 and d is broken, the local circuit is interrupted, and all of battery X again passes through the magnets of signal No. 1, clearing it.

It will be seen that a train, upon entering the section governed by signal No. 1, opens normally closed track instrument spring a, thus breaking the circuit that holds the points of block relay E in contact. These relay points separate, leaving signal No. 1 at danger. When the train passes signal No. 3 it closes normally open track instrument spring b^1, completing a circuit through coils H of interlocking instrument, thereby closing its normally open spring o and opening its normally closed spring p. The signal circuit is now broken both at points of block relay E and at spring p of interlocking instrument; but by closing spring o, the first of the two operations necessary to close the circuit which energizes the coils of block relay E is completed. The second operation is performed when the train passes over track instrument C, closing its normally open spring c. Instantly the coils of both block relay E and shunt relay D are energized, and their contact points closed. Upon the closing of these contact points, the local circuit through the coils of the interlocking relay is established and springs o and p restored thereby to their normal position. The signal circuit is now completed, but signal No. 1 will not clear so long as a train is passing over track instrument C, keeping its spindle up, owing to the action of the local circuit already described.

The Hall signals on the Chicago & Northwestern cover about 86 miles. The main lines of this road running out from Chicago extend westward, northwestward and northward. The line to the west has Hall signals from West Fortieth street, Chicago, to Turner, 25 miles. The line to the northwest has them from Clybourn Junction to Barrington, 29 miles, and that to the north has them from Deering to Waukegan, 32 miles. Following is the substance of the circular of instructions issued by the Superintendent:

The signals indicate danger by displaying a red disc by day and a red light by night. The absence of the disc by day or a green light displayed by night, indicates safety. A small portion of the red disc will be visible when the signal is at safety, at the upper left-hand edge of the opening in the signal case, and serves to show that the disc is there, and connected with the signal instrument.

The signals are located on the left of the track they govern [the trains run on the left-hand track], and have odd numbers for the northbound or westbound track, and even numbers for the southbound or eastbound track.

Each signal is connected with every switch in that block; that is to say, in the track it governs between it and the next signal in advance, and will indicate danger as follows:

1. When a train has passed it, but has not passed a clearing instrument 1,500 feet or more beyond the next signal.
2. When a switch in that block is open.
3. When a switch has been opened and closed, but has not had its clearing key operated after the switch has been returned to its normal position.

Clearing keys are in boxes on posts adjoining the switches they are to be used with. The boxes can be opened with a standard switch key.

By pressing the clearing key and keeping it closed while counting five (5), all the operations are performed upon the signals with which it is connected that would be performed in succession by a train in going out of the block after having entered it.

A train finding a signal at danger shall come to a stop before reaching it, and shall wait three minutes (unless the signal shall clear in less time) before proceeding. If the signal shall go to clear and come to a state of rest in the clear position, the train may proceed at the usual rate of speed; but, if the signal shall not have cleared, the train, at the expiration of three minutes, may, after placing three torpedoes as per rule, proceed cautiously and under full control, expecting to find a train or an open switch in the block. No part of a train shall stand within two (2) rail lengths on either side of a signal.

Any train stopped by a danger signal, or leaving a part of the train in one block to do work in the next block, or making an unusual stop, must protect the train as though there were no block signals back of them.

The conductor of a train taking a siding to allow another train to pass, after his train has cleared the main track and the *switch* has been *closed*, shall clear the signals governing the track vacated, by pressing the clearing key of the switch by which he left the main track.

The conductor of a train crossing over from one main line to the other to allow a train to pass, after his train has cleared the cross-over and *both cross-over switches closed*, shall clear the signals of the track vacated by operating the clearing key of the *cross-over switch* in *that track*, and upon returning to his proper running track, after his train has cleared the cross-over, and *both cross-over switches closed*, shall clear the signals of the track temporarily occupied by operating the clearing key of the cross-over switch in *that track*.

Opening *either* switch of a cross-over sets to danger the signals governing both blocks in which the cross-over is located, neither of which can be cleared until both switches of the cross-over are in their normal position.

A train allowing another train to pass it shall not come out on the main track until the train which has passed shall have reached the next signal, or had ample time to do so; but shall open the switch leading to the main track in order to keep the signal back of the switch at danger for its own protection.

Section foremen and the foremen of other crews having occasion to open a switch must attend to the operation of the clearing key. The key must *not* be operated if there is a train between the switch and the signals *next* back or ahead of the switch.

Section men and others using hand cars must *stop* before passing over *each* track instrument, and move over it slowly to avoid operating the signals. With heavily loaded push or hand cars, an iron or wooden shim must

be used to prevent the wheels from striking the lever of the track instrument. . . .

Conductors must report by wire all delays caused by signals. At the end of run, conductor and engineman shall fill out blank report cards to correspond with any stops they may have been obliged to make by reason of the signals, and send them to Division Superintendent. . .

To aid in giving the engineers and others a clear idea of the operation of the signals an experimental set was erected in a vacant building at Chicago, and all employés having to do with the signals were taken there and allowed ample time to examine the details of operation, a man being in attendance to explain any point not understood. A section of double track with a crossover was laid down, and full sized signals, switch stands, track instruments, etc., connected up as for regular service. The signal cases and the covers of the track instruments were removed so that the operation of the electrical instruments could be clearly seen.

Wilson's Block Signal Circuit.

The Hall Signal Co. prints in its new catalogue a description of the automatic signals erected some time since for the Kansas City, Fort Scott & Memphis road at Kansas City, and we reproduce the main part of it herewith. The peculiarity of the installation is the arrangement of circuits for automatic block signals, patented by Mr. A. J. Wilson, Superintendent for the company, by which the signals stand normally at danger and only show clear for a short time before the approach of the train. By reference to the diagram, fig. 4, it will be seen that this arrangement is very simple. The signals are operated by a rail circuit, which actuates a relay in the usual way. When a section of track is clear this relay remains closed, but it does not close the electromagnet which holds the signal disc in the clear position, for the reason that the so-called local circuit, running through the coils of the signal magnet, is extended back on poles to the relay of the next preceding signal, where it is held open, except during the passage of a train over the section controlling that relay. This will be clearly seen by reference to the middle signal in the diagram shown. The points of the relay for this signal are closed, thus closing (at that point) the circuit which goes into the signal case, but the circuit is held open at the relay of the previous signal (shown at the right of the cut), and it will remain open until a train enters the right-hand section, opening this relay and thereby closing the circuit which clears the middle signal. Assuming, therefore, that the line of road is straight and the weather clear, the engineman can see the signal of the second block turn from danger to clear as he enters the first block. A diagram of the Kansas City yard is shown in fig. 5. The normal position of all signals is danger. All main line signals are cleared upon the entrance of a train into the block preceding the one which they protect, provided all the switches in the block they protect are in normal position and no train is in the block, or within fouling distance of the main line.

The movement of any switch in the block from the normal position will place the signal protecting that block at danger. All signals on the main line are blocked when the first wheel of the engine passes a point 60 ft. beyond the signal.

An explanation of a few of the movements in this yard will serve to indicate the principle on which the signals are arranged and enable the reader to easily follow any of the combinations shown. The figures preceded by the minus sign (—) indicate the location of bells.

Signals 2, 4, 5, 8^1 and 8^2 are cleared when the switches are properly set for a train to proceed on to the main line from their respective sidings, provided no train is in the block.

Signal 1, located just north of bridge No. 1, is cleared by an approaching train when it reaches a point within 1,000 ft. of the signal; at the same time bell No. 1 is rung, notifying the switchman at that point that a train is approaching from the north. The circuit of this signal runs through both ends of the cross-over track and the switches in its block, and cannot be cleared unless these switches are in normal position. A train on passing a point 60 ft. beyond this signal sets it to danger and clears signal 3.

Signal No. 5 is a signal governing trains desiring to leave the siding at stock yards and cross over to the north-bound track. This signal will show clear only when switches are properly set for train to cross over, provided no train is on the south-bound track between the A., T. & S. F. connection and signal No. 7, or on the north bound track between signals 12 and 6.

Bell No. 2, located between switches 8 and 9, is set ringing when a train passes the A., T. & S. F. connection, informing the switchman at the stock yards' switch that a train is approaching from the north.

Signal No. 7 is located about 300 ft. north of the Kansas City Belt railroad crossing, and is connected with the derailing switch of that crossing. A train on passing a point 60 ft. beyond this signal sets it to danger and clears No. 9; at the same time it rings bells 3 and 4.

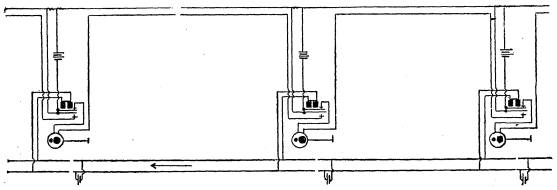

Fig. 4—Electrical Connection for Hall Automatic Block Signals on Kansas City & Fort Scott & Memphis Railroad.

The signal case marked 12 and 14 has two signals showing in opposite directions. No. 14 is to govern trains running south on the north bound track.

New York Railroad Commissioners' Report.

The Railroad Commissioners of the State of New York, Samuel A. Beardsley, Michael Rickard and Alfred C. Chapin, have sent to the legislature the tenth annual report of the Board. As usual the first chapter is on the general railroad situation of the country, and is devoted chiefly to the matters now before Congress. The legalizing of pools is recommended. The length of railroad in New York State, June 30, last, is reported as 7,656 miles, which is only five miles greater than the length reported the year previous.

Concerning changes in the law the report says:

Chapter 289 of the laws of 1889 created a commission to revise the general laws, and among them the railroad laws. The work thus begun, however, did not stop at revision. Before the Legislature had finally enacted the bills prepared by the commission, many changes, some radical, were made. The laws enacted did not go into effect until May 1, 1891. During the year when the law was in abeyance defects were discovered in it. The commission prepared a bill to correct these defects, which was presented to the Legislature of 1891. It failed to pass owing to the "deadlock" in the Senate of that year, and the "Railroad Law" of 1890 went into effect on May 1, 1891, uncorrected. During the year following the railroad corporations of the State were much embarrassed in the operation of their franchises under the incongruities of the law. This was not without advantage, however, as during the passage of the act of 1890 the attitude of the corporations had been obstructive; after a year's experience of the new law their attitude changed and they united with others in revision. The result was a bill which, after many amendments, became chapter 676 of the Laws of 1892. Six months experience of the law demonstrates that the railroad corporations are content with it. The public has gained greatly by the enactment of safeguards which selfish interests had heretofore defeated.

The law of 1887, forbidding railroad directors to issue bonds except on consent of the majority of the stockholders, was repealed by the law of 1892. The law of 1892 also reverses the policy of the state by requiring the consent of the Railroad Commission to the building of a new railroad. The decisions of the Commission in this matter are reviewable by the courts While this increases the responsibilities of the Commission another law weakens its power by abolishing the clause making the findings of the Board *prima facie* just and reasonable. This places the burden of proof upon the commissioners in enforcing their recommendations upon the railroads.

Grade crossings are discussed at length. The number of persons killed at such places during the past five years has been 238 and of injured 279. It is held that where a new highway is built across a railroad it should go over or under; the town should bear one-half the expense, and the courts should appoint a commission of three persons to determine the nature and cost of the bridge. Where an existing grade crossing is changed it is held that the Railroad Commissioners should determine the nature of the new crossing and apportion the expense, but no opinion is expressed as to the principles upon which this apportionment should be made. The legislature is urged to order a certain number of the more dangerous crossings changed each year.

The Commissioners hope that Congress will pass the law requiring M. C. B. couplers on freight cars, and they recommend that New York State require them on all cars after Nov. 1, 1898; the Commissioners, however, to have power to extend the time. Legislation is also recommended to require the equipment of a percentage of all freight cars with automatic brakes each year.

The danger from the five drawbridges between Albany and Spuyten Duyvil, on the New York Central, is held to be out of all proportion to the benefits accruing from their maintenance, and the Commissioners think that Congress ought to declare these small waterways no longer navigable, so that the drawbridges can be abandoned.

Concerning trespassers, the report says: "The number of persons killed and injured while trespassing upon the lines of the state is large. The statutes make such trespassing a misdemeanor, but these laws are not enforced. By common consent, magistrates discharge nearly all such offenders upon arraignment. Could the laws be made more rigorous, and the discretion of the magistrate be narrowed, the result would be a gain in the lessening of accidents."

On car lighting the seport says:

"Success has attended the effort to light passenger cars by gas. Last year the Board set on foot inquiries as to the practicability and safety of the various systems in use, and the answers were assuring in both respects. Indeed, so practical and so successful are the systems, and so widely have they been adopted, that a car in one of the first-class or limited trains lighted by oil would be regarded as a relic of a past age. A sufficient reason why every passenger car, whether a palace car or an ordinary coach, should not be lighted by gas cannot be given. Economy should not be the prevailing consideration. Aside from the increased security from fire, the annoyance of dripping oil from the lamps is avoided. The lighting of all passenger cars by gas is in line with the progress which has led to heating by steam instead of by stoves, and which is leading to automatic couplers instead of the link and pin, coupled by hand, and automatic brakes set from the engine rather than by men on the tops of cars at the risk of their lives. The prohibition of the use of oil by legislative enactment is desirable."

The behavior of passenger cars in collisions is next taken up, and it is stated that common passenger cars are too lightly built for safety, sleeping and drawing-room cars always being found to withstand shocks much more successfully. This is given as a result of the experience of the Board for 10 years, which must mean the experience of Commissioner Rickard, as the other Commissioners have only recently taken office.

Four persons have been killed and six injured by having a foot accidentally fastened in the narrow spaces between guard rails or in frogs. It has been claimed that blocking frogs introduces new elements of

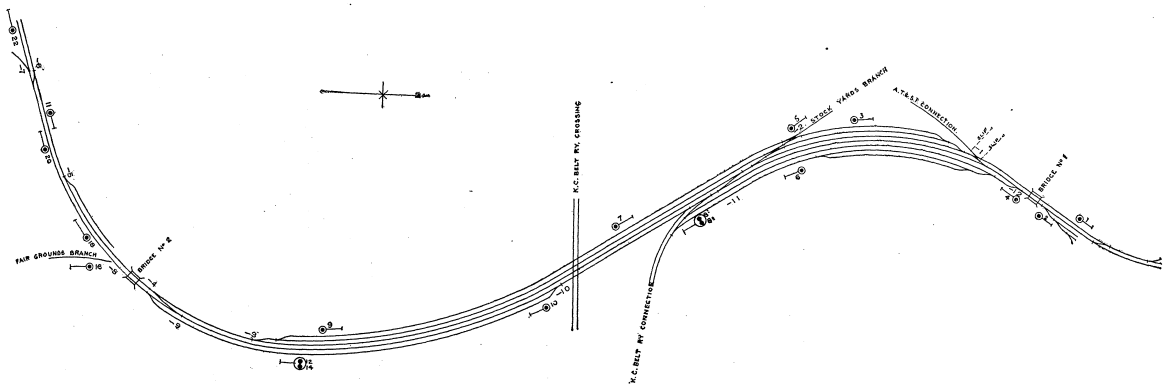

Fig. 5—Hall Automatic Signals in Kansas City Yard—Kansas City, Fort Scott & Memphis Railroad.