INTERSTATE COMMERCE COMMISSION

REPORT OF THE CHIEF OF THE DIVISION OF SAFETY COVERING HIS INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE NEW YORK CENTRAL RAILROAD NEAR AMHERST, OHIO, MARCH 29, 1916

APRIL 25, 1916

TO THE COMMISSION

On March 29, 1916, there was a rear-end collision on the New York Central Railroad near Amherst, Ohio, between two passenger trains, the wreckage from which obstructed an adjoining track and was struck by a passenger train running in the opposite direction. This accident resulted in the death of 25 passengers, 1 employee on duty, and 1 other person and injury to 37 passengers, 3 employees, and 7 other persons.

A public hearing was held in Cleveland, Ohio, on March 31 and April 1, 1916, and the Public Utilities Commission of the State of Ohio, which was then engaged in an investigation on its own initiative, was invited to and did participate in this hearing. As a result of the investigation as to the cause and nature of this accident the following report is respectfully submitted.

The accident occurred on the Toledo Division of the New York Central Railroad at a point about 1 mile west of Amherst, Ohio. The line at this point has three main tracks, and the general direction is east and west. The tracks numbered from north to south are 3, 2, and 1, track 3 being used by westbound trains, track 2 by high-speed and track 1 by low-speed eastbound trains. The movement of trains is governed by time-table and an automatic block signal system. The signals governing eastbound movements over this line are located on the south side of the track on bracket poles, the right-hand doll, or short mast, carrying the signals for track 1, those for track 2 being on the left-hand doll, the arrangement of tracks and locations of signals being shown by the accompanying diagram.

Located about 1 mile west of Amherst station is Amherst interlocking tower, at which point the four-track section from the east converges into a three-track section which extends westward. The interlocking plant at this point comprises a 40-lever Saxby & Farmer interlocking machine having 32 working levers. The tower is equipped with approach indicators and annunciators, track and signal indi-

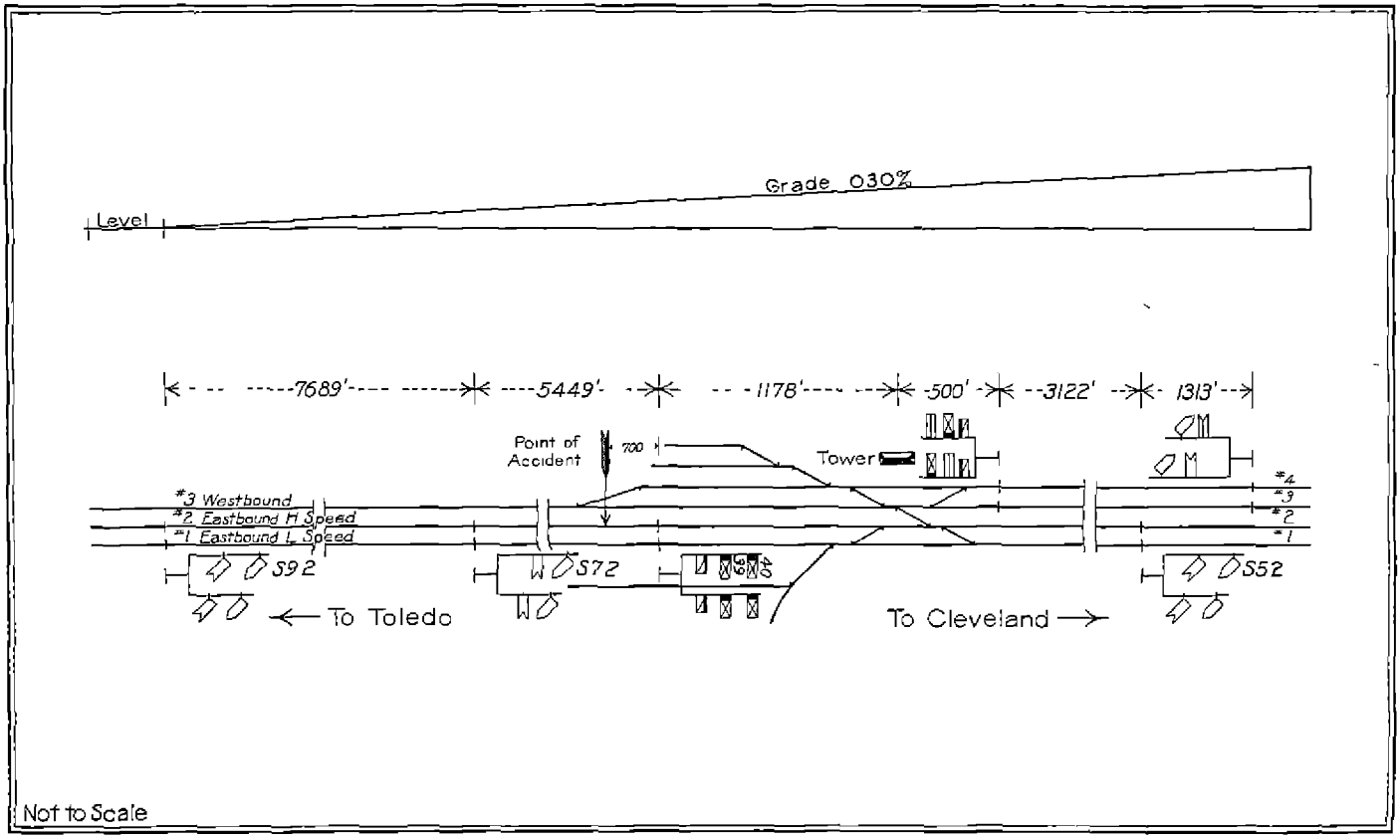

ILLUSTRATION No 1.—Diagram showing track layout and signal locations in vicinity of accident

cators, screw releases, and electric locks The plant is provided with approach and route locking The signals of the interlocking plant are of the upper quadrant type, normally displaying stop The top and middle arms are power operated, giving indications in three positions The bottom or calling-on arms and dwarf signals are mechanically operated, giving indications in two positions All signals, both automatic and interlocking, are equipped with long-time oil-burning lamps and at night display red for stop, green for caution, and white for clear

Located 1,178 feet west of Amherst tower are the home interlocking signals governing eastbound trains These signals are mounted on a bracket pole, each of the two dolls bearing three blades, the signals on the right-hand doll governing track 1 and those on the left-hand doll governing track 2 The top blade governing track 2 is signal 40 and is controlled by lever 40 in the interlocking tower This signal governs through movements on track 2, the middle arm is signal 39 and governs the crossover movement from track 2 to track 1, while the bottom arm is known as the calling-on arm and is used for low-speed movements

The two automatic signals involved in this accident are signals S7 2 and S9 2, the former being located 5,449 feet west of the interlocking signal 40 and the latter 7,689 feet farther west These signals are of the two-position, lower quadrant type, the top blade being the home signal and the bottom blade the distant signal for the next automatic home signal in advance, the distant blade on signal S7 2 also being controlled through interlocking signal 40 The home interlocking signals in normal position and two views of the automatic signals, displaying stop and caution indications, are shown in illustration No 2

When a train approaches Amherst on track 2 and passes signal S9 2, an indication is given in the tower by the approach indicator, and the approach annunciator also sounds

When the track between signals S9 2 and 40 is clear, and the route through the interlocking plant on track 2 is set up and free, both the home and distant arms on signal S9 2 are in clear position, and home signal S7 2 is also clear The distant arm at S7 2 remains in caution position, however, until lever 40 in the tower is reversed and signal 40 clears to 45° or 90° position, then distant signal S7 2 also assumes clear position

Signal indicator 39-40, located in the tower, is normally in horizontal position, and in that position indicates that signals 39, 40, and distant signal S7 2 are all in horizontal position In the train movement described, when either signal 40 or distant signal S7 2 has moved approximately 5° from horizontal position, the control circuit for indicator 39-40 is broken, and the miniature semaphore

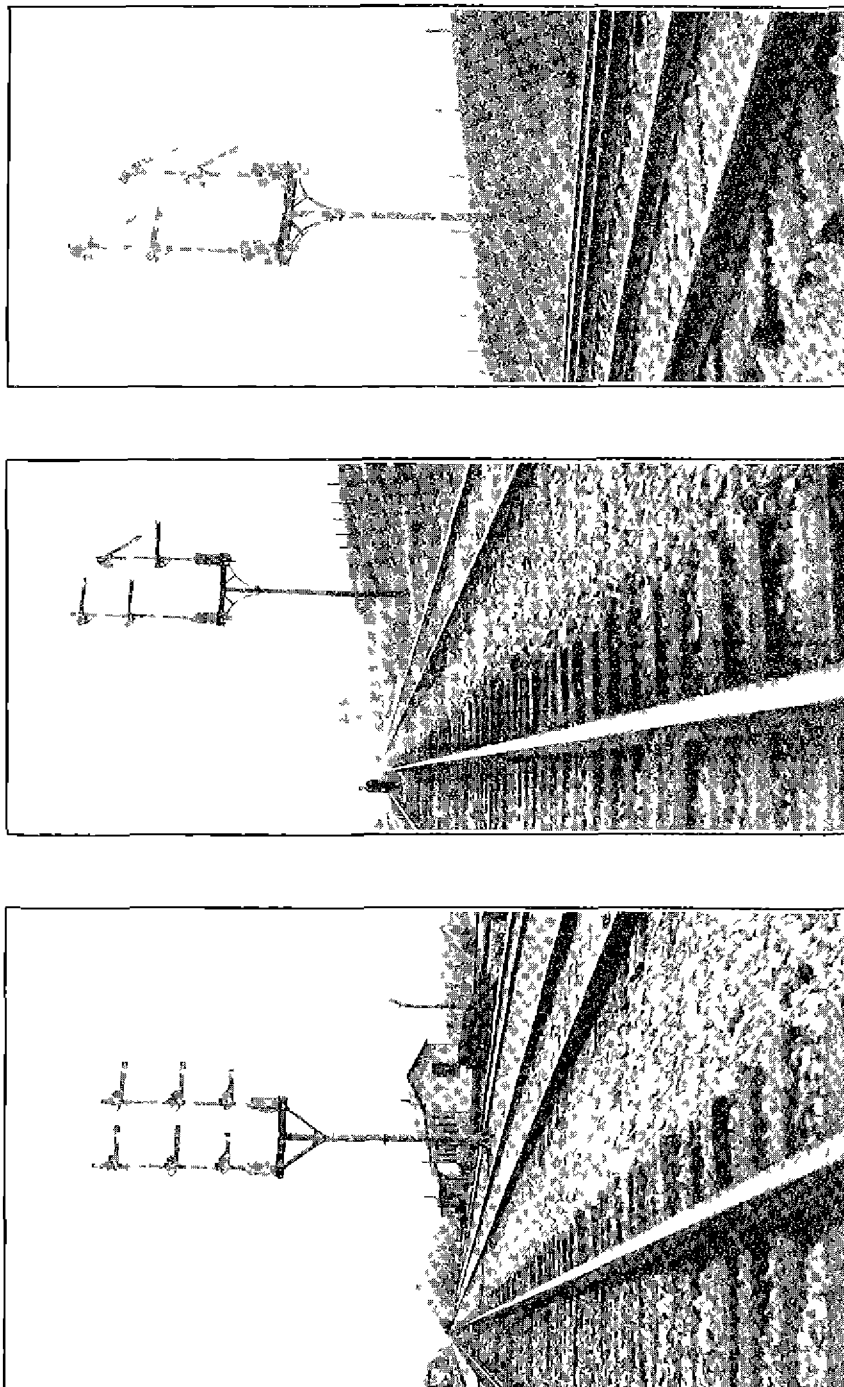

ILLUSTRATION NO 2 —Home interlocking signal with all arms in normal position, two views of automatic signals displaying stop and caution indications for track 2

on the indicator assumes its 45° position, which indicates that signal 40 and distant signal S7 2 have started to go to clear position This indicator is restored to normal position when signal 40 and distant signal S7 2 resume horizontal position, and either the track relay for the track section in advance of signal 40 is deenergized or a screw release in the tower is operated

The normal position of track indicator 40 is 45° below horizontal, indicating that the track between signals 40 and S5 2 is unoccupied and switch 17 is normal When the train passes signal 40 the track indicator goes to horizontal position and remains in that position until the train has passed signal S5 2 and lever 40 has been restored to normal position

The track from Amherst tower westward to Vermilion, a distance of 7 miles, is straight In the vicinity of the accident there is a grade of 0 3 per cent ascending eastward

The trains involved in this accident were the first and second sections of passenger train No 86, running eastward on track 2, and passenger train No 25, running westward on track 3

Train first No 86, running from Chicago, Ill, to Pittsburgh, Pa, was drawn by locomotive 4871, and was in charge of Conductor Bunnell and Engineman Leonard It consisted of the following cars, in the order named

Car	Construction	Year built	Weight	Length over buffers
			Pounds	*Ft in*
5282, baggage	Wood	1903	74,900	63 0
3758, postal	All steel	1914	133,600	64 6
Capita, Pullman	do	1913	154,000	81 10
Phillipston, Pullman	do	1912	151,850	81 10
Trotwood, Pullman	do	1911	152,600	81 10
Lesno, Pullman	do	1916	151,000	81 10
Rushville, Pullman	do	1911	152,600	81 10
Mahomet, Pullman	do	1914	152,400	81 10
186, club car	Steel underframe	1902	137,000	70 2
874, coach	All steel	1914	143,900	79 0

This train left Toledo, Ohio, at 1 43 a m, 8 minutes late, and passed Vermilion, the last open telegraph office, 67 67 miles east of Toledo, at 3 03 a m, 1 minute late Approaching Amherst tower, distant signal S7 2 was found in the caution position, the speed of the train was reduced, and the train was brought to a stop about 3 13 a m at a point approximately 200 feet west of interlocking signal 40, west of Amherst tower, on account of the signal being in the stop position The engineman sounded the whistle calling for the signal, and the signal was cleared When starting, the locomotive slipped and stalled and it was necessary to take the slack in the train This was done and the train started and had proceeded about six or seven car lengths when it was struck by train second No 86 at about 3 18 a m

Train second No 86, running from Toledo, Ohio, to Cleveland, Ohio, was drawn by locomotive 4881, and was in charge of Conductor Keller and Engineman Hess It consisted of the following cars, in the order named

Car	Construction	Year built	Weight	Length over buffers
			Pounds	*Ft in*
Thos Pullman	All steel	1911	110 800	81 10
Orville, Pullman	do	1913	148,000	81 10
1928, coach	Wood	1906	94,000	69 8
1926 coach	do	1893	79,800	61 3
1913, coach	do	1907	94 000	69 8
5567 baggage	do	1892	66,900	60 0
6044, express	Steel underframe	1912	63, 100	41 4
3112, baggage	Wood	1906	75, 500	68 0
5164, baggage	do	1893	86,000	63 10
861 baggage	do	1901	93, 300	63 2
Mansfield, Pullman	All steel	1911	142,600	81 10
Glenford Pullman	do	1911	150 800	81 9
Rutherglen, Pullman	do	1913	151, 100	81 10

This train left Toledo at 1 56 a m, 21 minutes late, passed Vermilion at 3 09 a m, 7 minutes late, and while running at a speed of between 50 and 60 miles per hour collided with the rear of train first No 86 at a point about 700 feet west of interlocking signal 40

Train No 25, known as the "Twentieth Century Limited," en route from New York, N Y, to Chicago, Ill, was drawn by locomotive 4813, and was in charge of Conductor Burke and Engineman Robertson It consisted of the following cars, in the order named

Car	Construction	Year built	Weight	Length over buffers
			Pounds	*Ft in*
Glenside club car	All steel	1912	132,100	80 5
East View, Pullman	do	1911	153,700	81 10
Calhoun, Pullman	do	1916	153,500	81 10
Cornell, Pullman	do	1916	153 500	81 10
Childwold Pullman	do	1914	152,900	81 10
Spuyten Duyvil, Pullman	do	1914	157,700	81 10
Green Island, Pullman	do	1914	153,700	81 10
Farnham, observation car	do	1911	149,600	81 11

This train left Cleveland at 2 34 a m, 4 minutes late, passed Amherst tower, 32 5 miles west of Cleveland, at 3 18 a m, about 2 minutes late, and while running at a speed estimated to have been between 50 and 60 miles per hour, collided with the wreckage from the collision of trains first and second No 86 which obstructed track 3

The locomotive of train second No 86 raised the rear end of the steel coach, the rear car of train first No 86, telescoping it for a distance of about 10 feet The forward end of the coach was forced under the rear end of the club car and the impact pushed the club car to the north onto track 3, practically at right angles with the track

The locomotive of train No 25 practically cut the club car in two, forcing one end of it westward, and through the superstructure of the steel coach, destroying the entire superstructure of the coach

Train No 25 was derailed by the collision with the club car, the train continued on the roadbed, overturning several of the cars in train second No 86, finally coming to a stop with its locomotive about 700 feet west of the point where it first struck the club car The locomotive and the first seven cars of train first No 86 and the two rear cars of train second No 86 remained upon the rails and were practically undamaged The condition of the wreckage indicates that

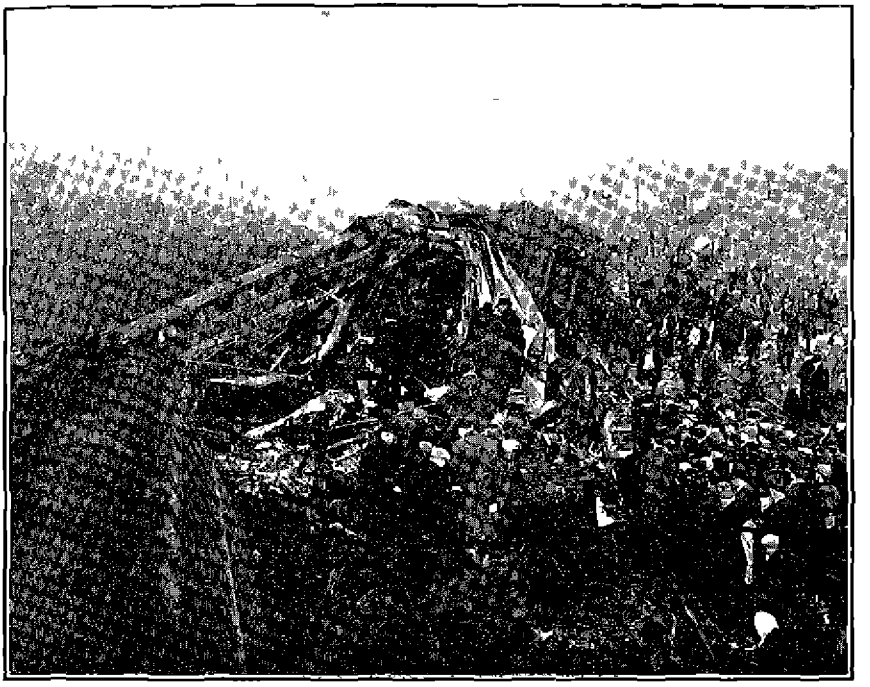

ILLUSTRATION No 3 —General view of wreck, looking west

the greatest damage and loss of life was caused by train No 25 colliding with the wreckage Illustration No 3 is a general view of the wreck

At the time of the accident the weather was very foggy The maximum speed permitted by passenger trains on this division is 70 miles an hour, but during foggy or bad weather the speed at which trains are to be run is governed by special time-table rule 551, which reads in part as follows

Enginemen are specially cautioned if any difficulty with machinery temporarily withdraws attention from constant lookout ahead, or weather conditions make observation of signals or warnings in any way doubtful, that they must at once so regulate speed as to make train progress entirely safe

The rules governing protection of the rear of a train by a flagman are in part as follows

99 When a train stops or is delayed under circumstances in which it may be overtaken by another train, the flagman must go back immediately with stop signals a sufficient distance to insure full protection When recalled, he may return to his train, first placing two torpedoes on the rail when the conditions require it

100a If an approaching train on the same track is within sight or hearing, the flagman must remain until it arrives

Towerman Ernst stated that he had been working at Amherst tower five nights and that on the morning of the accident the last train which passed his tower on track 2 ahead of train first No 86 was an extra at 2 05 a m From 2 05 a m he was engaged in reading until about 3 10 a m, at which time the annunciator sounded for train first No 86 He immediately went to his interlocking machine, looked at the indicators, saw that track indicator 40 was clear, indicating that the block was clear, he then pulled lever 40 over to clear signal 40, at the same time he again looked at the indicators and saw signal indicator 39–40 clear, indicating that signal 40 had gone to the proceed position He then returned to his desk and sat down After a few minutes the dispatcher called him on the telephone and asked him if train first No 86 had passed, and at about that time he heard train first No 86 sound the whistle for signal 40 He immediately went to the interlocking machine and noted that both track indicator 40 and signal indicator 39–40 were in the horizontal position and also that the latch on signal lever 40 was not properly seated by about three-quarters of an inch He at once restored the lever to normal and again reversed it, both indicators then going to the clear position, train first No 86 immediately sounded the whistle signal to recall the flagman The towerman stated that about a minute after he cleared the signal the second time for train first No 86 the annunciator sounded for train No 25 He then cleared the signal for that train, and it passed his tower between 3 17 and 3 18 a m The first information he had that there had been an accident was when he saw a flagman coming back with a lighted fusee in his hand At that time the weather was so foggy that he could see the lighted fusee a distance of only about a hundred feet Towerman Ernst stated that on two previous occasions at other interlocking towers he had experienced similar difficulty with a signal going back to the stop position after it had been cleared, but in each of those instances the occurrence was satisfactorily explained as coming from outside causes He could offer no explanation as to why the signal had not cleared properly when he first threw lever 40 over, and he thought it had cleared until he heard train first No 86 whistle for the signal

Engineman Leonard of train first No 86 stated that he first noticed fog at Ceylon, about 15 miles west of Amherst, and as he proceeded eastward its density increased, in the vicinity of Amherst the signals could be seen a distance of only about 200 feet He stated that as he approached Amherst he found signal S72, the distant signal for home interlocking signal 40, in the caution position He immediately reduced the speed of his train and at the same time sounded a blast of the engine whistle, calling for the signal, then drifted along and stopped his train about 200 feet west of the interlocking signal, and again sounded the engine whistle After the train had been standing about half a minute the signal cleared, he called in the flagman, started the train, and stalled He then took the slack and again started, and had moved about six or seven car lengths when his train was struck by train second No 86 The first shock was followed a few seconds later by a second shock, which was caused by train No 25, on track 3, colliding with the wreckage However, he stated that he did not see train No 25 until just as the rear end passed his locomotive He estimated that he used about three minutes in running from the caution signal to the home signal on account of the fog, being unable definitely to locate the signal, and that his train was struck about three minutes after it first came to a stop

Engineman Leonard stated that 10 or 15 minutes can generally be made up on the schedule of this train, regardless of fog conditions He stated, however, that in case of fog, if he thought he had missed a caution signal, he would slow right down the same as if he were running under a caution signal He stated that in his opinion, under the present system of signaling, it is safe to run a train at a speed of 60 or 70 miles an hour in such a fog as existed at Amherst, depending entirely upon signals for protection Engineman Leonard admitted, however, that if a train were to stop just beyond a home signal, and an approaching train under similar conditions missed the indication of the distant signal, it would be impossible to stop in time to avoid a collision Engineman Leonard stated that in his 28 years' experience as an engineman he has never found a false clear-signal indication

Fireman Robinson, of train first No 86, stated that he has had about eight years' experience as fireman and about two years as an engineman He stated that he first noticed the weather was foggy when his train passed Ceylon Approaching Amherst, signal S92 was in the clear position and at signal S72 the distant arm was in the caution position for both tracks 1 and 2 This signal he could see for a distance of about 300 feet When the train stopped at the interlocking signal, it could be seen a distance of about 200 feet He immediately got off and started to go to the tower, but after going

two or three car lengths the signal cleared and he returned to his locomotive The engineman then tried to start, but the locomotive slipped, after taking the slack the train was finally started He thought that the collision occurred three or four minutes after the train first stopped Fireman Robinson stated that 20 or 25 minutes can usually be made up on this run between Toledo and Cleveland, and that on the morning of the accident his train had made up all the time there was to be made up In his judgment, with the equipment that they had, a train might be run at full speed in a fog such as prevailed at Amherst at the time of the accident Fireman Robinson stated further that in his experience as a fireman and engineman he had never observed a false clear-signal indication

Conductor Bunnell, of train first No 86 stated that the first fog he noticed was at Baybridge, about 33 miles west of Amherst, and from that point east it lay in banks He felt the application of the brakes at the distant signal, and from that point the train drifted down to within about three car lengths of the home interlocking signal, where it stopped at about 3 15 a m At that time he was on the head end of the second car from the rear He got off on the ground and saw the flagman start back as soon as the train stopped He stated that the flagman had got back about one car length when he was called in by the engineman In starting the train the locomotive slipped and again stopped The flagman again got off and started back with lanterns and fusee After the train had started the second time he got on and had ridden a short distance when he heard a train using steam approaching in the rear and, thinking an accident was likely to occur, he jumped off and was climbing up the embankment when the accident occurred He stated that at that time the weather was so foggy that he could not see the fence along the right of way He did not believe that the flagman had reached a point more than one and one-half car lengths from the rear of his train when the accident occurred Conductor Bunnell also stated that he had never had any orders given him, and nothing had ever been said to him, as to whether trains should run fast or slow during a fog He stated that as a general thing he had not noticed any difference in the manner in which trains were run as between clear and foggy weather, and his train seldom lost time on account of fog He further stated that it was the practice to call in the flagman and wait for him to return if the train had not been standing any length of time Conductor Bunnell stated that the damage to equipment of his train was confined to the two rear cars

Flagman Beach, of train first No 86, stated that when his train left Toledo he saw train second No 86 standing at the station, but at that time it was not coupled up and he did not think it would follow the first section in less than 10 minutes He stated that he noticed

more or less fog between Baybridge and Amherst Approaching Amherst he felt the application of the brakes and immediately went to the rear of the train and lighted and threw off a 5-minute red fusee, this was thrown off at a point about three-quarters of a mile from the interlocking signal He stated that when the train stopped he immediately got off and went back to flag He had reached a point about one and one-half car lengths from the rear end when he was recalled by the locomotive whistle He returned to his train and signaled the engineman with the air whistle to go ahead, the train started forward, but stalled He then got off and started back again After he had gone about a car length he heard train second No 86 approaching, apparently about a mile distant He lighted a red fusee and started to run back toward the approaching train, and he thought he had reached a point about 10 car lengths from the rear of his train when train second No 86 passed him At that time the locomotive was using steam and running at a speed of approximately 50 miles an hour He did not hear the engineman of train second No 86 answer his signal He estimates that from five and one-half to six minutes elapsed between the time he threw off the fusee until he was passed by train second No 86 Flagman Beach stated that the rear lights on his train were burning and in good condition, but the weather was so foggy that he could see the fusee which he threw off for a distance of but three car lengths He also stated that the rule does not require a flagman to remain out when recalled, unless a following train is within sight or hearing, and as no train was within sight or hearing when he was recalled he returned to his train, as was customary

Engineman Hess of train second No 86 stated that prior to the trip on which the accident occurred he had been off duty about 65 hours On the night of March 28 he retired about 6 30 p m and was called about 11 p m After leaving Toledo the first fog that his train encountered was west of Huron, a station about 20 miles west of Amherst, and it increased in density as the train proceeded eastward He stated that after leaving Toledo all of the signals displayed clear indications, approaching Amherst there were two or three signals that he could not see until the pilot of his engine was abreast of them or until the engine was nearly under them, and he could no more than see them before he would be past them, but he was satisfied that he saw all of them He could not say positively that he recalled passing the overhead highway bridge located about 2,800 feet east of signal S7 2, because his mind was so thoroughly on the block signals He stated that approaching Amherst all the signals governing both tracks 2 and 1 displayed clear indications, except that distant signal governing track 1 at S7 2 displayed a caution indication He stated that he did not see any fusee near the distant signal, the first warn-

ing he received was when he saw a burning fusee on track 2 about two car lengths from the rear of train first No 86, and this he did not see until the pilot of his engine had nearly reached it At the same time he saw the flagman standing on track 1 He immediately made an emergency application of the brakes He estimated the speed of his train to have been about 50 miles an hour at the time the collision occurred Engineman Hess also stated that his train was running a trifle faster than its schedule on account of making up time and that it was his intention to bring it into Cleveland on time About an hour after the accident he went back to look at the home signal at the rear of his train, and found it in the stop position At that time he said to himself "It can not be possible that that block could be clear, and now against me" He said that the only restriction as to fog was that in case an engineman could not see the signals he must have his train under control in his opinion a fog would have to be of greater density than would permit an engineman to see a signal at the front end of his locomotive before it would be necessary to reduce speed Engineman Hess felt certain, in his own mind, that he did not miss any of the signals and that all of them displayed clear indications He stated that he believed that if he had been flagged and could have applied his brakes about 1,000 feet farther away, he probably would have been able to stop in time to avoid a collision Engineman Hess stated that in two instances within the last seven or eight years he has found block signals indicating clear when the block was occupied, but that in each of these instances he had discovered the train occupying the block in time to stop Engineman Hess further stated that early last fall he was called to the trainmaster's office and cautioned that regardless of weather conditions or anything else, he was to observe the home signals and go carefully and call the signals and be sure that both he and the fireman understood all the signals He stated that he had never had any trouble with his eyes and that he had passed successfully all the visual examinations At the time of the accident he was wearing glasses, but stated that they were prescribed by an oculist to relieve headache and that they did not in any way interfere with his vision

Fireman Turner, of train second No 86, stated that he first noticed fog at Sandusky, about 28 miles west of Amherst, and that from Vermilion east it became dense, the last signal which he saw was the first signal east of Vermilion about 6 miles from the point of accident, the remaining signals between Vermilion and Amherst he was unable to see on account of the fog Approaching Amherst so far as he was concerned, he was lost and did not know within a mile or two of where he was The first knowledge he had of train first No 86 was when he saw a burning fusee about three or four car lengths from the rear of that train and the pilot of his engine had nearly reached it

He said that at the time of the accident his train was running as fast as it could run, which was the usual manner in which these express trains were run in foggy weather, so long as they had a clear block He also stated that at this time of the year they have a great deal of fog in this territory, and the morning of the accident was not an unusual one so far as the fog was concerned He did not understand that the rules required trains to reduce speed in foggy weather, and said that it had not been the practice to do so

Conductor Keller of train second No 86, stated that the first intimation he received of the impending accident was the emergency application of the brakes, after which the train ran about three car lengths before the collision occurred Immediately after the accident he got off the rear car of his train, and at that time heard the crash of train No 25 striking the wreckage When he got off he saw the flagman of train first No 86 walking back from the east toward the rear of train second No 86 The fog at that time was so dense that he could see but about the length of one car Conductor Keller stated that when a train is stopped the flagman is required to go back immediately, and in bad weather he is required to remain there In his opinion on the morning in question the weather was such that it was proper for the flagman to return to his train upon being recalled, provided there was no following train within hearing or sight He further stated that in handling his train, when the flagman is recalled, he uses his own judgment as to whether the train shall or shall not wait for the flagman to return, being governed by the condition of the weather and the location of the stop He stated that he did not very often have occasion to leave the flagman, but when it was necessary he did so rather than take a chance

Flagman Gates, of train second No 86, stated that as soon as his train stopped he picked up his lanterns and started back to flag He reached the first signal in the rear of his train—the distant signal for signal 40—about 15 minutes after the collision occurred, and at that time both the home and distant blades were in the horizontal position, and the lights displayed were red for the top arm and green for the bottom arm At that time the signal could be seen a distance of 200 or 300 feet The signals remained in the same position until about 10 30 a m, at which time he was relieved by another flagman

Engineman Robertson, of train No 25, stated that when his train left Cleveland the weather was practically clear, and that he did not notice any fog until about 1½ miles east of Amherst, at which point it began to get a little hazy His train passed the station at Amherst at 3 15 a m At Amherst tower there was a locomotive on track 4, east of the home signal, which was making a great deal of steam and smoke, and the signal being obscured he applied the brakes and kept them applied until he was within 15 or 20 rods of the

signal, when he noted that it was clear He then released the brakes and was working steam when his train collided with the wreckage of train first No 86 at about 3 17 or 3 18 a m He stated that he did not at any time see the wreckage on the track ahead of him, the first knowledge he had of anything wrong was when his locomotive struck the wreckage and was derailed

When asked at what speed he thought a passenger train could be operated to insure safety in a fog so dense that signals could not be seen more than 100 feet, he stated that the rule he followed was to go right along as long as he was running on a clear block and saw the signals without difficulty, but that if he missed one of the signals he would know that he had done so and then would get ready to stop at the next signal Engineman Robertson further stated that fog made no difference in the speed so long as he was sure of the signal indications, and he thought the man on the locomotive was the one best qualified to say how fast his train should be run under such conditions, he stated that as long as he was sure of the signal indications he did not allow fog to interfere with his business He also stated that in all of his experience in running important trains, covering at least 10 or 12 years, he had never received a letter from the company when he had lost time on account of bad-weather conditions, neither had he ever received a letter calling attention to the fact that he had failed to maintain schedule time and asking the reason therefor Engineman Robertson stated that in his 35 years' experience as an engineman he had never found a home signal at danger, with the caution signal showing clear, nor a signal at clear when there was a train in the block He said his train would occasionally pick up a flagman, but that torpedoes had not been used much recently since the use of fusees was adopted He did not think that there was any necessity for reducing the speed so long as the engineman could read the signals as they were passed, even though the fog might be so dense that he could see only the distance from the cab to the pilot

Conductor Burke of train No 25 stated that he did not notice any fog until his train stopped after the accident and that he did not know at what time the fog had been encountered He stated that he had never been on a train when a caution signal was found indicating clear with the home signal at stop or when the home signal was at clear with a train in the block Conductor Burke stated that it was customary for the flagman to drop a fusee as soon as he felt his train slowing down, as soon as a train stops the flagman goes back immediately to protect his train, and he may return when recalled unless a following train is within sight or hearing He stated that he always waits for his flagman to return to his train or until

a following train brings him in, but as his train does not stop frequently this does not occur often

Head Brakeman Blakeney of train No 25 stated that after the accident, on account of the dense fog prevailing, he thought he could not see a signal or a lantern much more than the length of a passenger car He immediately started out toward the west for the purpose of stopping approaching trains, and in about 12 minutes caught up with the flagman of train second No 86 at a point near the distant signal Two minutes later they reached the first signal to the rear of train second No 86 and found the signals for both tracks 1 and 2 in the stop position, the top signal displaying a red light and the bottom signal displaying a green light He said he could see these signal indications a distance of about 125 feet

Towerman Fleckner, employed at Amherst as day towerman, stated that the tower at Amherst was put in service about two and one-half years ago During this period he had experienced some trouble with the signals dropping back to the stop position after the lever had been operated, and that this was particularly true of signal 40 This had occurred two or three times within the last six weeks He stated that if the lever is not pulled entirely over and properly latched the signal will remain in the stop position He is unable to account for the failure of the signal to clear, but in each instance, upon the lever being restored to normal and again reversed, the signal operated in the proper manner

Operator Prentice, at Vermilion, stated that train first No 86 passed his station at 3 03 a m and the second section passed at 3 09 a m , at that time it was cloudy, and there was a drifting fog, but the fog did not settle until about 4 a m Towerman Prentice further stated that a great deal of fog drifted in from the lake at various times and that at times it was so thick that he could just see the home signal pole, which is about 30 feet from his office, but that under such weather conditions trains ran right along as in clear weather He stated that not until after this accident did he notice any reduction in the speed of passenger trains during fog

Train Dispatcher Bausch stated that he had been employed as train dispatcher for about five years He stated that Operator Ernst reported a westbound train passing his tower about 2 50 a m About 3 15 a m he called Amherst and asked if train first No 86 had passed Ernst replied that it was standing west of the interlocking signal, but was then starting About this time Operator Ernst reported that the weather was very foggy Dispatcher Bausch stated that between Toledo and Vermilion, a distance of 67 miles, train first No 86 made up 7 minutes, and train second No 86 made up 14 minutes, and he expected that both sections would reach Cleveland

approximately on time He also stated that the fact that these trains made up this time in 67 miles was not an unusual occurrence and raised no question in his mind as to any danger that might exist, even though the weather was extremely foggy He stated further that on the morning of the accident no train was delayed on account of fog and all trains made their schedule time Between Toledo and Cleveland telegraph offices are located about 7 miles apart This he said, gives him an opportunity to know the speed trains are making, and had it been necessary he could have stopped them and instructed them to reduce speed However, in his experience as a dispatcher, he had never considered it necessary to do this He stated that dispatchers have no instructions regarding any action that shall be taken in case of dense fog in block-signal territory, but they depend entirely upon the vigilance of the enginemen in observing the signal indications

Night Chief Train Dispatcher Hancock stated that he knew a dense fog prevailed along the line the morning of the accident and knew that trains first and second No 86 were making up time, however these conditions did not alarm him as to the safety of train operation He stated that in case dense fog is reported, and trains run faster than 70 miles an hour, no action is taken other than to report it, but so far as the operation of trains is concerned the reports of fog conditions are of no value to him He also stated that it is not an uncommon occurrence to have fog along his division at this season of the year, but he has never personally made a check to ascertain whether trains were making up time in a dense fog He stated that it is his understanding "that when trains are running right along, the responsibility for the running of the train rests entirely with the engineman, and under time-card rule 511 he is to control the speed of the train according to the weather conditions prevailing" He stated further that he did not think that any responsibility rested upon the directing officer, and for that reason he never assumed any such responsibility or took any action in the matter

Road Foreman of Engines Freeman stated that in November he called Engineman Hess's attention to the necessity for the close observance of signals and rules, and while he did not say anything about making up time in foggy weather, he told him that if time were lost on account of not being able to see signals nothing would be said He stated that he thought an engineman should be able to observe and read signals very plainly while running at a speed of 60 miles per hour in a fog as dense as that which existed at Amherst at the time of the accident

Trainmaster Sullivan stated that the speed at which an engineman runs his train is purely a question of his own judgment They had not been given instructions that dwelt wholly upon foggy conditions,

but all passenger enginemen were cautioned specifically and given to understand that they were not under any pressure to make time that "we want the trains operated safely, regardless of time" He stated that the only observation he had made as to whether or not enginemen run slower in a dense fog is the observation he had made as a trainmaster in riding over the division He has never had occasion to take up with enginemen the question of running too fast during a fog He stated that when riding on trains he has timed enginemen, since the speed limit was placed at 70 miles per hour, and the highest rate of speed which he ever has observed was 72 miles per hour

Mechanical Superintendent McBane stated that from his study of the condition of the equipment after the accident he believes that in the first collision the locomotive of train second No 86 went under the platform of the rear car of train first No 86, raising it up, the forward end of the car went under the platform of the club car, and the club car, by the impact, was crowded northward and fouled track 3 It is his opinion that the damage done to the rear car by the first collision was not as serious as that caused by train No 25 driving a part of the body of the club car back along the side of the coach

Examiner Russell stated that about two years ago he examined Engineman Hess for vision and color sense, and at that time he passed a perfect examination, he also stated that so far as the requirements of the company are concerned Enginemen Hess needs no glasses

Signal Supervisor Whitcomb, of the Toledo Division, stated that he reached the scene of the accident on the relief train at about 6 20 a m He at once checked up the position of the signals, finding them at block In company with Maintenance Foreman Gall, tests of signal S7 2 and of the track circuits were made All wires, circuits, and mechanisms were tested and all contact points were examined, but nothing was found that would have caused an improper indication Later these tests were checked up with Mr Sibila, from the signal engineer's office There was nothing disclosed by the tests to indicate why signal S7 2 should not have operated properly and have been at stop behind train first No 86 After the wreckage was cleared away and the rails had been replaced and the track bonded, the signals cleared and operated properly No other repairs were made

Mr Whitcomb stated that he has had instances of false clear signals reported to him, and in every case when the signal was found to be improperly clear the cause was located He knew of no cause by which the signal in the rear of a train standing at signal 40 would go to clear He stated, however, that if the track were broken

between the rear of train first No 86 and the signal in the rear foreign current might cause it to clear improperly It requires 0 075 ampere to cause the track relay to close, and about 0 035 ampere is the minimum current that will hold it closed Tests were made to detect foreign current With track unbroken no foreign current was detected, but when both rails were broken there was a fluctuating current varying from zero to 0 040 ampere No tests were made to determine the source of this current and Mr Whitcomb was unable to say, without further tests, whether or not this current came from other parts of the signal system There had been a case at Sandusky where bond wires were broken by a dragging brake beam, and the signal had cleared with a train in the block due to foreign current In his investigation at Amherst nothing was found which would cause such a condition, and his careful inspection showed the plant to be in proper condition He did not believe that there was any foreign current present in these rails, while the contacts were all clean and in no danger of sticking

Mr Whitcomb referred to the delay sheets, as sent in daily by the towermen at Amherst showing instances in which signal 40 was reported as failing in the stop position The following are all the failures of signal 40 which have been reported since the plant was placed in service in August 1913

September 1 1913 No trouble found
September 13 1913 Operator too slow in throwing lever to avoid delay to train
September 17 1913 Track circuit trouble, due to wet track relay would not hold up
December 23 1913 Short circuit in switch head rod Intermittent trouble
January 28, 1914 Broken rail
February 21, 1914 Maintainer failed to connect up wire in changing control relay
February 27, 1914 Signal went to stop in face of train account men rewiring signal
July 23, 1914 Maintainer found no trouble
July 24 1914 Maintainer found no trouble
January 19, 1915 Piece of wire between rail and insulated joint
March 8, 1916 Broken bond wire
March 29, 1916 No trouble found

Maintenance Foreman Gall stated that he arrived at the scene of the accident about 6 15 a m He was with Mr Whitcomb during the tests, when all signals were found to be in proper condition, and all relays concerned were inspected and found to be working properly

Mr Gall, in his 10 years' of signal experience had had knowledge of several false clear signal failures He stated that foreign current, by which is meant current from outside sources is one of the most common causes, that from other parts of the signal system usually

being termed cross currents False clear signals have also been caused by relays sweating, due to sudden changes in temperature forming enough moisture to freeze, holding the armatures against the coils, also defective mechanisms or broken parts, and by lightning fusing relay contacts Mr Gall stated that if signal 40 failed to clear, or dropped back to stop after having been cleared, it was necessary to restore lever 40 to normal position and then operate it in the usual manner in order to clear signal 40 This arrangement is used so that if levers are left reversed the signal does not clear automatically after the block is cleared, and operators are compelled to restore levers to normal position after the passage of trains before the signal can again be cleared A "stick" indicator is used, which is controlled by track conditions in advance of the signal, when that section is clear for the passage of trains this indicator is energized and circuits are completed through its contacts When lever 40 is reversed one branch of the circuit through the relay coil is opened, but the indicator relay is maintained energized by another branch of the circuit, through one of its contacts, so long as the track section in advance of signal 40 is clear After the passage of a train the indicator relay can only be energized by placing lever 40 in normal position which closes the first branch of the circuit above mentioned

Mr Gall also stated that a "stick" indicator circuit is used to show the position of home and distant signals When the home signal begins to clear this indicator goes to the clear position After this indicator goes to clear, because of the operator reversing lever 40 it can not be restored except by first opening the track relay for the section in advance of signal 40, through occupancy by a train or otherwise Mr Gall stated Operator Ernst's claim that the indicator was horizontal when train first No 86 stopped shows that the distant signal was at caution He believes that lever 40 could not have been pulled over far enough the first time to clear the signal, and that the operator was mistaken in thinking he saw the indicator clear Contacts controlling signal 40 are connected to the lever and not to the latch Mr Gall thought there was no possibility that the top arm of signal S7 2 could be stuck at clear and so cause the lower or distant arm to stay clear, as both home and distant signals S7 2 were found horizontal immediately after the accident, which would be their proper position, and would indicate that they were working properly at that time

Chief Draftsman Sibila of the signal department stated that he assisted Mr Whitcomb in testing signals near Amherst after the accident He found everything in proper working order, and made no changes of any kind

Maintainer Deiner stated that he had been stationed at Amherst since October 1909, and that he covered about 13 miles of road The interlocking plant at Amherst is the only one in his territory He arrived at the scene of the accident at about 5 30 a m and found it so foggy that the light of a signal could be seen only about 100 feet

Since signal 40 was installed, about 2½ years ago, that signal had been reported to him about 10 times as not working properly, 7 or 8 times something was found wrong and repaired, and 2 or 3 times no trouble could be located Usually some time elapsed between different reports of trouble He stated that lever 40 does not have to be pulled all the way over and latched, as the signal will clear when the lever is about 1½ inches from the end of its stroke If not latched and it jumps or is jarred back far enough, the signal goes to the stop position It can then be cleared again in the usual way after putting the lever to normal position Mr Deiner stated he had had false clear signals only during freezing weather, when signals were covered with sleet or the semaphore shafts were frozen

Signal Engineer Wiegand described the arrangement of tracks in the vicinity of Amherst and the location of signals, both interlocking and automatic The interlocking signals have square-end blades, while the automatic signals have pointed ends Trains may not pass the square-end arms without authority The distant arm on first automatic signal west of Amherst is the distant signal for home signal 40 and is therefore controlled by the position of arm of signal 40 None of the automatic signals are in any other way controlled by the interlocking signals The interlocking home signal is semiautomatic it goes to stop when a train passes it and the operator can not again clear it while there is a train in the block When an automatic signal indicates stop the rules permit a train to proceed, after coming to a full stop The upper arm being clear and the lower arm horizontal indicates one clear block, both arms inclined indicates two clear blocks in advance Overlaps are not used When operating properly, with train first No 86 standing at the home signal at Amherst interlocking, both arms of automatic signal S7 2 would be horizontal and a red over a green light would be displayed The next signal west, S9 2, would have the upper arm inclined downward and the lower arm horizontal, with a white light displayed over a green light The third signal to the west would display two white lights

No personal investigation of the apparatus was made by Mr Wiegand after the accident, as he was in Chicago No changes have been authorized, and orders were issued that no work should be done

Questioned as to the practice of running under a caution signal, Mr Wiegand said that instructions now in force are to the effect

that any train approaching a green, or caution, signal must slow up and run cautiously until it receives a clear indication On no part of the road, however, is it required that a passenger train wait for a clear signal before proceeding, it may go when the signal indicates caution

Mr Wiegand said it was possible for a signal to indicate clear with a train in the block, but was hardly probable at Amherst Some causes of such failures are Foreign current with broken rail, mechanical trouble, such as rusty signal shafts, and electrical troubles, such as grounds, etc If stuck in the clear position, due to a rusty shaft, a signal would remain so, even after a train passed The circuits at Amherst are so designed that two separate grounds would be necessary to result in a false clear indication from that cause

There are approximately 795 signals on the Toledo Division, each arm being counted as a separate signal, and three-position arms being counted as two signals This, said Mr Wiegand, would mean that an engineman covering the whole division would observe and interpret about 400 signal indications in each direction

During the past two years there have been 13,501,435 signal movements, and 9 false clear signal indications, or 1,500,159 movements for each false clear failure The following is the record of these failures for the past two years

July 15, 1914 Signal S401 remained in clear position with switch set for other than main track, due to construction man making improper connection

September 14, 1914 Distant signal S252 remained clear with train order signal at block, caused by control wire grounded on guy wire This was insulated line, but the insulation had worn through

December 1, 1914 Distant signal S451 stuck clear, account counter catching on slot arm This was caused by counter becoming disconnected, the operating arm turning over, preventing slot arm from dropping

February 9, 1915 Signal 1921 (distant arm) stuck clear, account rain seeping in where doll pole was leaded into the bearing casting and freezing armature and slot bearings

September 12 1915 Home signal S332 stuck clear behind train, account jumper wires broken, due to a brake beam dragging This allowed foreign current to come in and hold up relay

December 14, 1915 Distant signal S614 stuck clear account water getting into cap over shaft and freezing

December 21, 1915 Distant signal S101 was stuck clear with home ahead at block, due to control wires grounded in underground cable, caused by mice chewing insulation

January 18, 1916 Home signal S142 remained clear with train in block, account nut bridging contacts on back of lightning arrester

January 28, 1916 Home signal S128 remained clear with train in block, account relay armature freezing in picked-up position, due to relay sweating

In reference to the failure of September 14, 1914, Mr Wiegand said it is the practice to have the automatic distant signals serve as

distant signals for the train-order signals whenever they are so located that such a method is possible, this failure would not have prevented this signal from going to block behind a train He had no record, other than that contained in correspondence, of false clear failures reported to his office, investigation of which failed to disclose that the signal was in the clear position improperly and failed to develop any defect which could have caused such failure When failures are discovered, special forms are used for reporting them and any reports turned in become a part of the record Mr Wiegand could recall only one case where a false clear failure had been reported, and a careful investigation failed to locate the cause This case occurred at Oil City Tunnel, and in order to guard against some of the trouble at this point a polarized relay was installed

Referring to the statement of Engineman Hess that he had experienced some false clear failures at West Park within the past several years, Mr Wiegand submitted the following record of such failures in that vicinity from March, 1906, to February, 1909

April 10, 1908 Signal 184 5 remained clear after train passed cut section, and was due to bond wires being broken by vibration at the channel pin The break, being between the train and the signal, allowed foreign current to pick up the relay

February 25, 1909 Signal 186 1 Failure due to ice in bottom of relay and armature freezing up Moisture, probably due to condensation

March 5, 1909 Signal 196 1 Home and distant arms clearing at the same time, with train in second block, due to distant control wire grounded on guy wire

July 16, 1910 Signal 184 2 Failure due to control wire for upper blade being grounded between the instrument battery case and a night switch in watchman's shanty

The last case is the only failure reported about the time right-hand running was put into effect, that change being made west of Cleveland on July 24, 1910 Mr Wiegand said it would be hard to say if these signals, having failed in clear position would have remained in such position The grounds in the latter case may have been intermittent

During the two years mentioned, in which there were 13 501 435 signal movements, there were 1,160 "safe" failures, or 1 to 11 639 signal movements In each instance investigation was made and cause usually found In a few cases the cause of failure was not ascertained It is preferable for a signal to fail in the stop position for, while it may stop a train it gives protection in the rear of any train Therefore, circuits and mechanisms are so designed that in case of failure the signal will assume the stop position

Mr Wiegand submitted records of the tests of the relays at signal S7 2, at the cut track section between signals 40 and S7 2 and the relays at Amherst interlocking plant, made during the past two

years, and also a record of the test of control relays of signal 40 made by Foreman Gall on March 30, 1916 Apparatus was inspected as follows

September 10, 1914, Report No 2728, Amherst interlocking
December 3, 1914 Report No 2815, Amherst interlocking
September 13, 1915 Report No 3387, Amherst interlocking
December 17, 1915 Report No 3550, Amherst interlocking
June 15, 1914 Report No 2573, Signals S7 2 and S9 2
April 27, 1915 Report No 3103, Signals S7 2 and S9 2

The inspections are made by an inspector from Mr Wiegand's office twice a year for interlocking and once a year for automatic signals The interlocking inspections are made about three months apart, in order to see that the points found during the first inspection are taken care of

Mr Wiegand did not believe it was possible that distant signal S7 2 could have been clear at the time train first No 86 was attempting to get started He stated that the circuits are so designed that if the automatic distant arm is held in the clear position mechanically the circuit for the relay controlling the home arm on the doll is broken and that the circuit can not be made until the distant arm is in the horizontal position Then the home relay is picked up and the armature is held up by a circuit through its own contacts, the home relay being, therefore, of the "stick" type This would have no bearing on the operation of signal 40, but the operation of the two arms on signal S7 2 would be controlled in that way, so that if the distant arm stuck clear behind a train the home arm would have been at stop

At interlocking plants approach locking is provided, Mr Wiegand stated, so that it is impossible to change the route within the interlocking limits except when the home and distant signals are both in normal position By means of a "stick" indicator employed in home signal control circuits, it is necessary that a train pass through the interlocking or the operator use his "screw release," requiring about 1½ minutes, after a home signal has been cleared, and the home and distant signals must both again be normal before the route can be changed This indicator primarily shows that both the home and distant signals have gone to their normal positions, and incidentally shows when the home signal starts to clear There is no indicator in the tower to give the operator positive information that the signal has cleared Although Operator Ernst says this indicator went to the horizontal position after having gone up to 45°, Mr Wiegand stated it could not have done so unless something had gone through the interlocking or unless he had released it himself

There had been no trouble with foreign current in the vicinity of Amherst, and the 0 035 ampere found when the track was broken

might have been due to leakage from adjacent track sections It would be an impossibility for there to be sufficient leakage of this character to clear the signal falsely Insulated joints are tested once each year, or whenever the condition of the insulating fiber indicates a break-down of the joint If the current reading across the joint is 0 475 ampere it is satisfactory, but if more than 0 950 ampere it is considered defective

Signal Engineer Elliott, of the New York Central lines east of Buffalo, stated that false clear-signal indications have occurred on that portion of the line under his charge, and that if there is anything possible that may go wrong about a signal system to cause such an indication it is only a matter of time when that cause will result in the giving of the wrong indication

He stated that he had been at Amherst, was familiar with the general situation there, and had heard the testimony, it was his opinion that, under the conditions existing at the time of this accident, it would not have been possible for foreign current to have caused the signals in the rear of train first No 86 to display a clear indication Neither did he know of any other cause which would produce a false clear-signal indication if the signals had gone to the stop position after the passage of train first No 86

Relative to the possibility of foreign current producing a false clear-signal indication, Mr Elliott said that when the track is shunted by a train, as was the case at Amherst, it is difficult for sufficient current to flow into the track circuit to operate the track relay If the track circuit is broken and foreign current is present a small amount of current backs up through the relay and may operate it There is practically no danger of foreign current from high-tension power lines, as no trouble will occur unless there are grounds in at least two places Mr Elliott stated that the general study he has made of the matter of foreign current would apply equally to automatic stops as to automatic signals

Speaking of the practice on the lines east of Buffalo relative to speed in foggy weather Mr Elliott could not recall any rule governing the matter, similar to the rule in effect on the lines west of Buffalo, but from his experience he was of the opinion that if the engineman could see the signals he could safely maintain speed Density of fog would not enter into the question of speed if the signals were observed The real basis of safe running is the signal indication As to the safety of running 60 miles an hour in a fog, with roadway signals 25 or 30 feet from the cab, when an engineman can not see a greater distance than 48 feet, Mr Elliott did not believe that under such conditions the signals could be seen at all by the engineman as he passed them

Mr Elliott said that he had heard of the white indication being taken from the light that can be seen between the lens of the lamp and the signal roundel, but this had occurred only when the observer was standing immediately under the signal, and he knew of no case where such an indication was read when the train was running, even at low speed He stated that by changing the color of the clear indication from white to green it would absolutely eliminate any danger of getting an improper clear indication in this manner, and that green is much the safer color to indicate proceed, the greatest benefit to be obtained from employing green as the color of the clear signal indication, however, being the elimination of any chance of misreading a signal should a roundel be broken, orders have been issued to make this change on the lines west

Relative to the method of train protection by flagmen on the New York Central lines, Mr Elliott stated that on the lines east of Buffalo a flagman is not recalled after having gone back to protect the rear of his train, if his train starts immediately he does not go back, but after having once gone back he does not return to his train if he has gone so far that he can not catch it after it starts In short, it is not the practice to recall a flagman, and when he goes back he goes to stay He thought that under certain conditions it would be safer to require a flagman to stay out to flag a train every time a passenger train stopped, rather than to have him come back to his train if he was recalled

Mr Elliott stated that he considered the automatic signal the safest method of train operation in use to-day When asked if he could suggest anything that would provide safety under such a situation as he thought existed at Amherst, he replied "An automatic train-control device would, but I know of no practical device that may be installed that would secure safe working" Mr Elliott stated that following an accident at Batavia, the New York Central made an offer to the signal companies for the installation of an automatic signal system that would enable trains to run as at present, but not take the control from an engineman's hands so long as he was bringing his train properly to a stop between distant and home signals, but that if at any time the speed of the train should be accelerated between the distant and home signals so that there was any chance of the train passing the latter, the device should operate to apply the brakes Personal experience in testing an automatic stop device in 1893 caused him to add as an additional requirement that after the brakes were once applied they could not be released until the train was brought to a stop This offer, which still stands, was made to the signal companies because they were thought to be best fitted to develop apparatus of that kind

He stated that great progress has been made in the development of automatic stop systems since his tests of 1893 and that he has kept in touch with the advancement of the art, but that the deeper he goes into it the more hopeless it seems to be able to find a device which will give real protection

Mr Elliott also stated that while there might be some device that would provide certain additional safety, up to the present time he knew of no device that would give such additional protection as would counterbalance the disadvantages and unsafe conditions that would result from its use He stated that only a small percentage of accidents could be prevented by the use of an automatic stop, and were it not for the factor of preventing loss of life there is no question that from an operating standpoint the use of an automatic stop is undesirable, because of the difficulties, complications, and unsafe conditions it would introduce Mr Elliott stated that "What we are after is to secure a safety device that would let us operate our trains as they are at present without taking the control out of the engineman's hands", that if the engineman is performing the braking of his train as it should be done and is keeping the speed below the "braking curve speed" the device should not operate to apply the brakes, because there is no necessity therefor, that when the device does operate to cause a brake application the engineman should then not be permitted to release the brakes until the train has come to a stop, and that if the automatic device is arranged to cause a brake application at a fixed point—braking distance from the danger point—then the brakes will be applied "so far from the point at which you are required to stop that if the conditions change or make it possible for you to go ahead, as it would be on the clearing of the signal, then you have to stop your train unnecessarily, and you introduce more conditions by stopping than by allowing the engineman to retain control and go ahead"

Concerning measures to prevent the recurrence of such accidents, Mr Elliott could suggest nothing more than better discipline

General Superintendent Ingalls, of the third district, embracing the territory within which this accident occurred, stated that shortly after the automatic signals were installed the officials realized the necessity for the men either to see the signals or to stop or slow down, and, anticipating that most of the trouble would occur during the winter, instructions calling attention to the necessity for the proper observance of signals have been issued every fall for several years past, sometimes by the general manager and at other times over the signatures of the superintendents It was found necessary to go even further, and a practice was adopted of sending for each engineman to come to the office for the purpose of talking over the matter in a serious manner, and in that way forcibly impressing upon him

that safety must be had before speed, and that weather conditions would not be accepted as an excuse for failure to observe signals Mr Ingalls stated that he had told committees representing the men, and they had agreed with him, that they could not operate safely under automatic signals if they permitted the condition of the weather, whether from fog, snow, or sleet, to be used as an excuse for not observing the signals, and that this is generally understood over the road Mr Ingalls stated that the older men said that they would, as opportunity offered in lodge meetings and at other places, take that position with their fellow employees, particularly with reference to the younger and inexperienced men When asked what had been done in the way of attempting to ascertain by inspection, observation, or tests, whether or not these instructions were being complied with, he said that a man with a knowledge of railroad operation, riding up and down the railroad all the time, knows what is going on He stated that the evidence in this case showed that no dispatcher, superintendent, or anyone else was competent to advise as to weather conditions, saying that the testimony indicated that east of Amherst there was little or no fog, and that this fog was encountered suddenly, and that for this reason they left it to the man on the locomotive, he was the only man that knew when he encountered fog Referring to the testimony of one of the enginemen, wherein he stated that he operated his train at normal speed unless he found that he had missed a signal, Mr Ingalls stated that unless a man knew the road, every inch of it, he had no license to run 60 miles an hour in a dense fog, but that the men on the trains involved were absolutely competent, and knew every signal on the road With respect to tests conducted for the purpose of determining whether or not the men observed signal indications, Mr Ingalls stated that the instructions were that they should be made with reasonable frequency, preferably every 60 days, in whatever manner the judgment of the division officer indicated was best, that they must exercise great caution not to fix up a trap for the enginemen, and that they must not make the tests at any point where they might endanger life While the trainmen were not informed of these instructions, nevertheless tests were not made at dangerous points, such as railroad crossings, for fear that the employees might think the derail was open, which might result in trouble, neither would a light be flashed suddenly in a man's face, or a switch stand be turned in such a manner as to indicate that the switch was wrong, although the switch really was in the proper position, nor a home signal be placed in the danger position with the caution signal indicating clear, in fact, all tests are to be made under such conditions as might be encountered by the employees on any trip made by them Mr Ingalls further stated that he had a record of 8 efficiency tests with

respect to the observance of signals made during the last 30 months in which Engineman Hess was involved, in each of which he had a perfect record Mr Ingalls further stated he personally knew that within 12 months every train on the lines west of Buffalo had been checked by a competent man to see that a speed of 70 miles an hour had not been exceeded between any two stations, and in the past year no 30-day period had passed without attention being given to the matter, particularly on the Toledo Division Mr Ingalls further testified that the chief instructions to flagmen are contained in the book of rules and that in addition they are given special instructions with respect to different situations Torpedoes are seldom used, in such a case as was shown to have existed on the night of the collision, when all the main tracks were blocked by this accident, and it was known that trains would be there for some time, torpedoes are used Under ordinary conditions, however, torpedoes, if placed on the track, are taken up Mr Ingalls stated that he considered the indiscriminate use of torpedoes in automatic signal territory to be an element of danger rather than of safety, saying that a great many trains are run, making a great many stops, and when a man gets an automatic signal that shows the track to be clear, and he knows it to be clear, and he then runs over torpedoes, he soon begins to pay no attention to them He stated that if a man misses a signal he probably will get into trouble in any event, regardless of whether or not he runs over torpedoes Mr Ingalls further stated that he felt that in this instance the flagman complied literally with the rules, although, in view of what had happened, it would be easy to say that he should not have returned to his train Relative to whether or not greater safety would be obtained by following the method of flagging as used on the lines east of Buffalo, he said that the operating methods and conditions are so radically different that he did not think any fair comparison could be made On the lines west of Buffalo there are two tracks for each direction, and they give a train whichever track is free for use, while on the lines east of Buffalo there are also two tracks for each direction, but one is ordinarily used for freight trains and the other for passenger trains Under the system of operation on the lines west of Buffalo, if the flagman remained out every time a passenger train stopped he might wait 20 or 30 minutes and then along would come a train which they would not want to have stopped with a fusee or torpedo, especially in a fog, for the purpose of allowing the flagman to get on and ride He stated, however, that the greatest danger to the train was during the time the flagman was returning to his train after having been recalled

A statement submitted by General Superintendent Ingalls, covering the territory under his jurisdiction, showed that for a period of two years, ending March 1, 1916, there had been conducted 1,203

efficiency tests to ascertain the observance of signals by enginemen, and 1,166 tests as to proper flag protection These tests resulted in the failure of 12 enginemen and 4 flagmen to meet all the requirements of the rules During the same period there were 12 instances reported in which enginemen had overrun signals, and 7 instances in which flagmen had failed properly to protect their trains

An examination of the evidence in this case disclosed that while Flagman Beach would undoubtedly have been able to go back a much greater distance if he had not returned to his train when recalled, and he might have been out far enough to warn the engineman of train second No 86 in time to avert the collision, nevertheless he complied with the flagging rule, and followed the customary practice in effect in his territory In this connection it is noted that Flagman Beach threw off a lighted five-minute fusee as his train slowed down approaching Amherst As trains first and second No 86 passed the last station west of Amherst about six minutes apart it is probable that the fusee had entirely burned out before train second No 86 reached the point where it had been thrown off

In view of the fact that the danger from rear-end collisions is greater when a flagman is returning to his train, increased safety would be provided if the practice were changed so as to require that when a flagman goes back to protect the rear of his train he shall not be recalled, at least in foggy or inclement weather

In order to determine the cause of this accident, careful consideration has been given to the testimony particularly the statements of the towerman who was on duty at Amherst and the engineman of train second No 86, and in addition, on April 3, 4, and 5, the Commission conducted a thorough investigation and made comprehensive tests of the interlocking plant and the block signals concerned

The investigation disclosed that, prior to the arrival of train first No 86, all track circuits, signals, and indicators were working properly Distant signal S7 2 and interlocking signals 39 and 40 were in horizontal position and the route was clear for a through movement on track 2, track indicator 40 being in clear position and signal indicator 39–40 being in horizontal position

Upon the arrival of train first No 86 at signal S9 2, the approach indicator and annunciator in the tower operated properly, and, according to the towerman's statement, he reversed lever 40 and indicator 39–40 assumed its 45° position, this indicated that either or both signal 40 and distant signal S7 2 had moved at least 5° from horizontal position In the interval between the time train first No 86 passed signal S9 2 and arrived in view of signal S7 2, signal 40 and distant signal S7 2 returned to horizontal position, as train first No 86 received a caution indication at the distant signal and a stop

indication at the home signal In view of the towerman's statement that both indicators 40 and 39–40 were in horizontal position just prior to the clearing of signal 40 the second time, the track relay for the section in advance of signal 40 must have been open at this time, due to some unknown cause, necessarily involving a failure of the track circuit However, this trouble, if any existed, whatever its cause, must have disappeared immediately, for the reason that when the towerman restored lever 40 to normal position, track indicator 40 assumed its clear position, indicating that the track relay for that section was then properly picked up, and when lever 40 was again reversed signal 40 cleared as in normal operation

The statement of Towerman Ernst that he found lever 40 was not latched in reverse position when train first No 86 came to a stop and whistled for the signal may explain why signal 40 was not cleared properly the first time, or did not remain clear for train first No 86, for the reason that if the lever was not thrown entirely over to reverse position and was left on the quadrant more than 2½ inches from reverse latching position, or, if it was thrown entirely over and then bounded or worked back, signal 40 either would not clear at all or would not remain clear But if this occurred, it could have had no effect upon the track relay for the section in advance of signal 40, nor upon the tower indicator 40, and while, if the track relay did open, as stated, the signals and indicators would have operated as described, there was, so far as known, no condition existing which should have opened the track relay referred to It is apparent, therefore, that unless some temporary abnormal condition existed, which is not believed to have been the case, the track relay for the section in advance of signal 40 did not open, and it seems probable that Towerman Ernst is in error regarding the operation of tower indicator 40 The fact is also clearly established by the towerman's own statement that he did not properly operate lever 40 the first time in order to clear signal 40 for train first No 86

The investigation disclosed that there was no necessity for stopping train first No 86 at signal 40 The failure properly to clear that signal resulted in causing an unnecessary stop, and while it is true that this unnecessary stop led up to the condition which rendered this accident possible, train first No 86 was stopped at a point where there might be a good reason for stopping that particular train at any time, and where undoubtedly other trains are frequently stopped It is obvious, therefore, that the question of whether or not lever 40 was properly manipulated has no bearing upon the direct cause of this accident Automatic signals S9 2 and S7 2 are provided and arranged to furnish protection for a train

standing in the block under just such circumstances as existed in this instance

According to the statements of the engineman of train second No 86, the signal indications received by him at signals S9 2 and S7 2 were both clear, but as train first No 86 was still occupying the block west of signal 40 this would necessitate a false clear operation of the home automatic signal S7 2 The towerman stated that just prior to the clearing of signal 40 the second time for train first No 86, signal indicator 39–40 was in its horizontal position, therefore, both interlocking signals 39 and 40 and distant signal S7 2 must have been in horizontal position, and this would indicate that signal S7 2 was working properly at that time Moreover, when the signals were inspected shortly after the accident occurred, distant signal S9 2 and both home and distant signals S7 2 were found in horizontal position, giving proper caution and stop indications in view of the conditions existing, and after the wreckage had been cleared away and the track repaired these signals operated properly without any adjustments or repairs being made to the signal circuits or apparatus

Tests made by the railroad company within a few hours after the accident occurred failed to disclose any abnormal condition of the signal system or interlocking plant, or any cause which might have led to failures either of the track circuit for the section in advance of signal 40 or of the automatic signal S7 2 A careful and thorough test of all features of the interlocking plant and the automatic signal system which were in any way concerned in these operations, made on April 3, 4, and 5, demonstrated beyond question that all the apparatus involved was in proper working condition at the time this examination was made

This accident was due to one of two causes Either the automatic signals failed to operate as intended, and displayed false clear indications, or the engineman of train second No 86 failed to observe and obey the caution and stop indications properly displayed by those signals

The investigations and tests disclosed that unless some temporary abnormal condition existed immediately before the accident occurred there was nothing which could have caused such a false clear failure as would be necessary to display the clear signal indications which, according to the statement of the engineman, were displayed for train second No 86, the possibility that any such abnormal condition existed is exceedingly remote

The conclusion is therefore reached that the engineman of train second No 86 must have been mistaken regarding the signal indications displayed, due either to his failure to see the signals or to read the indications properly, on account of the dense fog and the speed

at which his train was running, and it is believed that this accident was caused by his failure to observe and obey the caution and stop signal indications displayed by signals S9 2 and S7 2

On the night of April 4 observations were made for the purpose of determining the point nearest to the signal at which an engineman of an approaching train could see the red and green lights of stop and caution signal indications, as well as to ascertain whether or not it was possible, with the signal arms in horizontal position, to see the white light from the signal lamps shining beneath the signal-blade castings These observations were made from locomotive 4875, headed east on track 2, the weather being clear and the night dark It was found that with the front end of the locomotive practically opposite the signal pole both red and green signal lights could still be clearly seen With the locomotive standing in that position at signal S9 2 the following measurements were taken

Distance from engineman to point on track opposite center of signal pole, 35 feet 9 inches

Distance from engineman's eye to center of distant signal roundel, 16 feet 5 inches

Distance from engineman's eye to center of home signal roundel, 12 feet 5 inches

When the locomotive was moved forward and reached a position where the engineman was about 13 feet west of signal S9 2, the first glimmer of white light between blade castings and signal lamps could be seen, the red and green indications being entirely obscured at that point, and when the engineman was approximately 7 feet west of the signal the white lights could be distinctly seen The distance between lens of signal lamp and signal roundel at signals S9 2 and S7 2 varied from $1\frac{1}{4}$ to $2\frac{3}{8}$ inches

Measurements which were taken at signal 37 2 disclosed that at a point 38 feet 10 inches west of the signal the red and green lights could still be plainly seen, at 19 feet the white light between lamp and blade casting could first be seen, and at 8 feet 10 inches the white light could be seen clearly The locomotive was run past this signal at low speed, and it was noted that just before passing the signal it was possible to obtain a very brief glimpse of the white light between lamp and blade casting However, it is believed that even at low speed this flash of light was not sufficiently distinct to be accepted by an engineman as a clear signal indication

Engineman Hess is 49 years of age He entered the service of this railroad as fireman in 1887, and was promoted to engineer in January, 1892 The more serious entries against his service record are as follows

January, 1900 Suspended 2 weeks for running block at LeCaine

April, 1902 Suspended 7 days for running by Danbury contrary to his orders, which he had forgotten

May, 1908 Suspended 15 days for running automatic signal 198–2
May, 1910 Suspended 20 days for running one-arm signal in block position at Oberlin
December, 1915 Suspended 10 days for striking rear end of train No 9 at Toledo station

Between October, 1913, and the day of the accident Engineman Hess had been involved in 8 efficiency or surprise tests, in each of which his performance was perfect

The evidence indicates that Mr Hess is an experienced and competent engineman, that he had had adequate rest, and at the time of the accident was in the best of health and that his mind was free from worry and outside care The only apparent explanation, therefore, for his failure to heed the signal indications is that he became lost in the dense fog which prevailed in the vicinity of Amherst

The record of this accident, together with a careful consideration of the accompanying tabulation showing accidents investigated in connection with which employees have failed to observe and obey signal indications, brings forcibly to mind the fact that the rules relative to speed permitted during foggy weather are in many instances indefinite and vague

It is apparent in this instance that the provisions of rule 551 were not observed, and the high rate of speed at which train second No 86 was running, in view of the fog and the short distance at which signal indications could be distinguished, was one of the proximate causes of this accident If Engineman Hess had been running his train at reduced speed, as is evidently contemplated by rule 551 instead of running at normal speed, and even making up time, in all probability he would have been able to read the signal indications properly and this accident would have been averted Not only train second No 86 made up time in the fog, but all three of the fast trains involved in this accident made up time during the night, and the testimony of practically all of the employees clearly indicates that foggy weather makes no difference in respect to the rate of speed at which trains are run It is clearly shown, also, that the operating officers charged with the responsibility of knowing that safety rules and requirements are observed, were perfectly familiar with the fact that trains not only run at normal speed but make up time in dense fogs

The requirements of safety in train operation are not properly fulfilled unless rules promulgated for the purpose of providing safety are strictly observed by employees and rigidly enforced by those in authority

In the present case, while those charged with the operation of trains issued rules and instructions which they consider sufficient to provide adequate safeguards in foggy weather, yet no instance was

disclosed where any check or observation had even been made to insure that rule 551 was complied with, in fact, the evidence justifies the conclusion that those in charge must have known that trains were continually being operated at the same rate of speed in fog as in clear weather

While it undoubtedly is true, as stated by Mr Elliott, that the real bases of safe running is the signal indication, and density of fog would not enter into the question if the signals were observed, nevertheless, when the signals are obscured by fog or storm, and the range of vision is correspondingly limited, it is manifest that the possibility of an engineman missing a signal is greatly increased, and the practice of permitting fast trains to run at normal speed under such conditions constitutes a grave menace to the traveling public

During foggy or stormy weather, when signal indications can be seen but a short distance, positive and definite instructions should be given prohibiting the running of trains at high speed

Accidents such as this may be expected to occur unless those in charge of the operation of this property at once take steps to see to it, by such check, observations, and other means as may be found necessary, that speed is materially reduced in foggy weather

The following is a tabulation of accidents investigated since July, 1911, wherein employees have failed to obey fixed signal indications

Date	Railroad	Location	Kind of accident	Number of persons— Killed	Number of persons— Injured	Weather conditions	Cause
1911							
July 11	New York, New Haven & Hartford	Bridgeport, Conn	Derailment	14	51	Clear	Train crossed over from one track to another at excessive speed; engineman failed to obey signal and rule
Sept 4	Lake Shore & Michigan Southern (Pennsylvania trains)	Dock Junction, Pa	Collision, side	3	36	do	Engine crew disregarded signals
Oct 19	Pere Marquette	Detroit, Mich	Collision, head-end	1	49	Fog	Contributing cause was failure of engineman to observe and obey signal protecting switch
Nov 2	Erie	Smithboro, N Y	do	1	0	Clear	Engineman disregarded block signals and flagman's signal
Dec 9	Chicago Milwaukee & St Paul	Corliss, Wis	do	1	3	Fog	Contributing cause was failure of engineman to obey signal indications
1912							
Feb 17	Pennsylvania lines west of Pittsburgh	Larwill, Ind	Collision, rear end	4	11	do	Failure properly to protect train and failure of engineman to observe and obey signal indications
Feb 20	Boston & Maine	North Adams, Mass	do	1	2	Clear	Either false clear signal or failure to observe signal indications
July 4	Delaware Lackawanna & Western	Corning, N Y	do	39	102	Fog	Failure of engineman to observe automatic block signal indications and flagman's signal; failure of flagman to use torpedoes
July 14	Chicago, Burlington & Quincy	Western Springs, Ill	do	13	29	do	Failure of flagman properly to protect train; failure of engineman to control speed and to obey signal indications
Oct 3	New York, New Haven & Hartford	Westport, Conn	Derailment	7	33	Clear	Failure of engineman to observe and obey signals and rules governing operation of trains over a crossover
Oct 18	Delaware, Lackawanna & Western	Hallstead, Pa	Collision, rear end	2	0	Fog	Failure of flagman properly to protect train; failure of engineman to observe and obey signal indications
Oct 27	Lehigh Valley	Homets Ferry, Pa	do	1	1	do	Failure of engineman to observe and obey signal indications; failure of trakeman to call engineman's attention to danger signal; failure of flagman properly to protect train
1913							
Mar 14	Union Pacific	Gothenberg, Nebr	do	4	13	Blizzard	Failure of engineman to bring train under control after passing caution signal, and failure to observe and obey danger signal
Do	do	Herdon, Nebr	do	5	2	do	Failure of engineman to observe and obey signal indications; failure of conductor and flagman properly to protect train
June 12	New York, New Haven & Hartford	Stamford, Conn	do	6	25	Clear	Failure of engineman to apply brakes in time to stop train before reaching home signal, which was in "danger" position
July 27	Lehigh Valley	Slatington, Pa	do	1	31	do	Failure of engineman to obey signal indications
July 30	Pennsylvania	Tyrone, Pa	do	1	216	do	Failure of engineman to observe and be governed by signal indications; failure of fireman and assistant road foreman of engines properly to observe signal indications
Sept 2	New York, New Haven & Hartford	North Haven, Conn	do	21	42	Fog	Failure of flagman properly to protect train; failure of both enginemen to control speed of trains before passing danger signal; signal system inadequate
Sept 4	Chicago, Milwaukee & St Paul	Penfield, Mont	Collision, head end	2	11	Clear	Failure of train crew to obey train order; failure of conductor and engineman to obey signal indications

Date	Railroad	Location	Kind of accident	Number of persons— Killed	Injured	Weather conditions	Cause
1914							
Jan 29	Pennsylvania	Conemaugh, Pa	Collision, rear-end	3	9	Fog	Failure of engineman to obey signal indications failure of conductor and flagman to protect train
Mar 22	Cleveland, Cincinnati Chicago & St Louis	Indianapolis, Ind	Derailment	2	5	Clear	Failure of engineman properly to observe and obey signal indications
July 17	Virginian	Fairmount Park, Va	Collision, crossing	7	91	do	Failure of motorman to obey signal indications at crossing
1915							
Jan 1	Chicago, Burlington & Quincy	Liberty, Mo	Collision, head end	0	16	do	Failure to keep train clear of superior train failure of engineman to obey signal indications
May 17	San Pedro Los Angeles & Salt Lake	Los Angeles, Cal	do	0	4	Cloudy	Failure of yard crew to keep locomotive clear of first-class train and observe and be governed by automatic signal indications
Aug 4	New York, New Haven & Hartford	Atlantic, Mass	Collision, rear side	0	23	Clear	Failure of engineman to observe and obey signal indications
Nov 24	Southern	Salisbury, N C	Collision, rear end	2	38	do	Failure of flagman properly to protect train failure of engineman to have train under control passing signal
Dec 17	Baltimore & Ohio	Felton, Pa	do	5	22	Fog	Contributing cause was failure of engineman to obey signal indications due to fog and high speed, incomplete protection afforded by switch indicator
Dec 23	Delaware Lackawanna & Western	Slateford, Pa	do	2	9	Clear	Failure of engineman to obey signal indications
1916							
Feb 5	Southern Pacific	Jackson, Utah	do	1	1	Fog	Occupying main track on time of superior train failure of engineman to obey signal indications
Feb 7	Chicago & North Western	Dunlap, Iowa	do	4	2	Clear	Failure of flagman to protect train failure of engineman to obey signal indications
Feb 22	New York, New Haven & Hartford	Milford, Conn	do	10	266	do	Failure of engineman to obey signal indications

Of the 31 accidents included in the foregoing tabulation, resulting in the death of 166 persons and the injury of 1,141 persons, there were 11 instances in which the signals were more or less obscured by fog, and in 2 of the accidents by a blizzard

This accident again directs attention to the fact that competent and experienced enginemen are not infallible, and that even a modern and complete block-signal system does not afford absolute protection against disastrous collisions, with their consequent loss of life and destruction of property As has been stated in previous reports, when trains are operated at high speed while the weather is so thick and foggy that signals can be seen a distance of only a few feet, no system of roadside signals can provide that measure of protection to which the traveling public is entitled The number of serious collisions which have occurred within the past five years, due to enginemen failing to observe and obey roadside signal indications, demonstrates how imperative is the need of some device that will supplement the human element and assume control of the train in case the engineman fails properly to control his train

It is not reasonable to expect that devices of this character can be fully developed by private enterprise to meet all of the exacting requirements that may be laid down for an ideal automatic speed-control system As was stated in the last annual report of this division, "the foundation of any automatic train-control system must be an automatic train-stopping device, and it is vital first to develop the train-stopping device itself in all essential features to a high state of reliability and efficiency When this foundation has been established, speed-control features can be added, or such other refinements as may be desirable or necessary to provide for special operating conditions and requirements" Many automatic train-stop devices have been devised, several of which have been brought to a comparatively high state of practical development, and which, if installed and used for the purpose intended, would undoubtedly increase the safety of railroad operation If the railroads are to fulfill their obligations to the traveling public, steps should be taken at once to avail themselves of such devices and actively to assist in their further development

It is to be noted that the rear car of train first No 86, in which all but two of the fatalities occurred, was a modern steel car built in 1914 It is thought that the collision between trains first and second No 86 resulted in no great damage to this car, and that but few passengers were killed in this collision It is believed that when train No 25 struck the wooden club car, with steel underframe ends, the force of the impact carried one of these steel end castings length-

wise through the steel superstructure of coach 874, causing the greater number of deaths and serious injuries

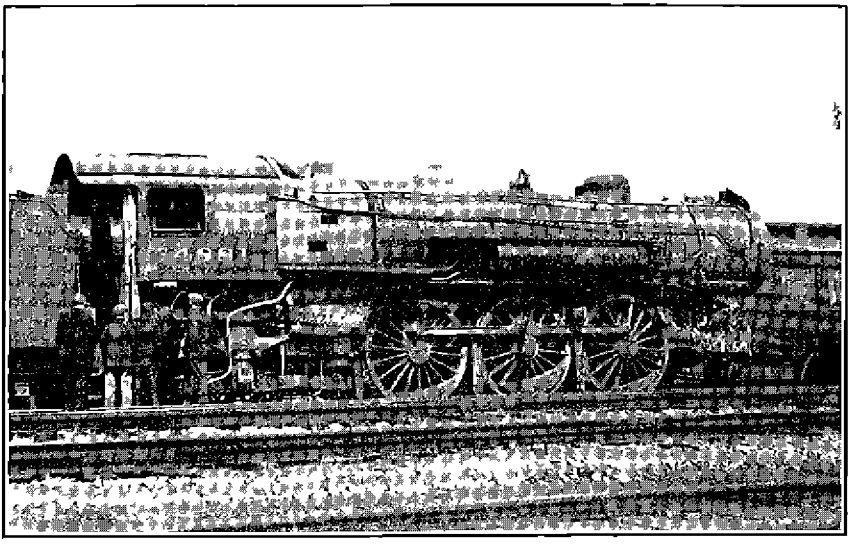

ILLUSTRATION No 4.—Showing damaged condition of locomotive 4881 of train second No 86 after removal from wreckage

This conclusion is borne out by the fact that, as shown in illustration No 4, locomotive 4881, hauling train second No 86, was not seri-

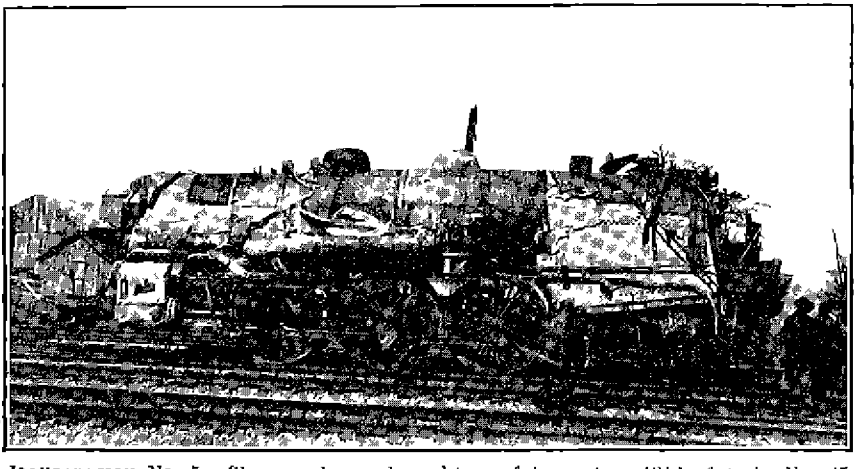

ILLUSTRATION No 5.—Showing damaged condition of locomotive 4813 of train No 25 after removal from wreckage

ously damaged, by illustration No 5, showing the seriously damaged condition of locomotive 4813, hauling train No 25, and by the further

fact that the underframe of steel coach 874 was damaged for a distance of only about 15 feet, evidently by the force of the first collision, while the entire superstructure was torn away and demolished when train No 25 ran into the wreckage

Respectfully submitted

H W BELNAP,
Chief, Division of Safety

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