

INTERSTATE COMMERCE COMMISSION

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY CONCERNING AN
ACCIDENT ON THE PENNSYLVANIA RAILROAD AT BALTIMORE, MD.,
ON JULY 25, 1933.

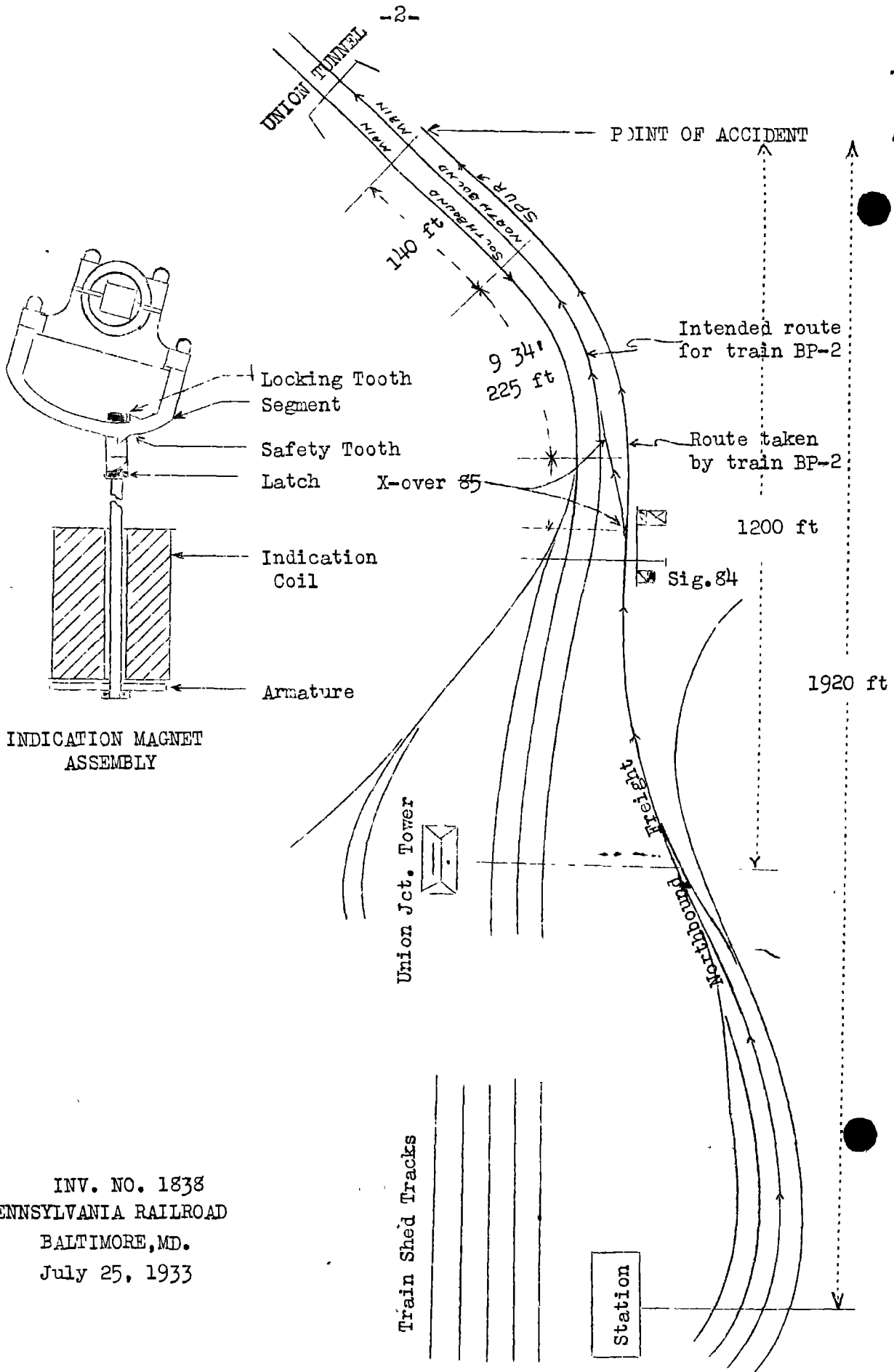
November 29, 1933.

To the Commission:

On July 25, 1933, there was a derailment of a freight train on the Pennsylvania Railroad at Baltimore, Md., which resulted in the injury of 4 employees and 2 other persons.

Location and method of operation

This accident occurred in the Baltimore Terminal at a point about 1,920 feet north of the passenger station, within the limits of Union Junction interlocking plant and about 1,200 feet north of the tower. Approaching Baltimore Terminal from the south on the Baltimore Division there are two main tracks through B. & P. tunnel which merge with two main tracks from the west at the north portal of the tunnel and from that point northward there are numerous tracks through the terminal. The passenger tracks pass directly through the train shed and the freight tracks take diverging routes around both sides of the passenger station, while north of the station all tracks again converge into two main tracks leading to Union Tunnel. Baltimore Terminal territory from the north portal of B. & P. Tunnel to the south portal of Union Tunnel is protected by two electro-pneumatic interlocking plants and train movements are governed by electro-pneumatic semi-automatic signals operated from interlocking machines at B. & P. Junction on the south end, and Union Junction on the north end, with a form of traffic locking between the two interlocking plants on all through tracks. All tracks between the two interlockings are signalled for traffic in both directions and the cooperation of the signal-men-operators in both towers is required in order to change the direction of movement. The north-bound freight track branches off from the main track to the right near B. & P. tower; the track then consists of a series of short tangents and curves varying from $9^{\circ} 30'$ to $13^{\circ} 40'$, followed by tangent track 110 feet in length to a no. 15 crossover where the track again merges with the north-bound main track. A spur track, 480 feet in length, leads off to the right at the south end of this crossover, parallels the main track and ends at a point about 80 feet from the embankment at the south portal of Union Tunnel. The spur track is tangent for a distance of 115 feet, followed by a $9^{\circ} 34'$ curve to the left 225 feet in length, and 140 feet of tangent track. The accident occurred at the north end of this spur track, the grade for north-bound trains being slightly descending.



INV. NO. 1838
 PENNSYLVANIA RAILROAD
 BALTIMORE, MD.
 July 25, 1933

The switch and signal involved in this accident are controlled and operated by the interlocking at Union Junction Tower. Movements from the north-bound freight track to the main track are made through crossover 85 in reverse position, while movements to the spur track are made with crossover 85 in normal position. The switches at crossover 85 are controlled and operated electro-pneumatically, from lever 85 in the tower. Signal 84 is a two-arm, upper quadrant semaphore signal, mounted on a signal bridge spanning the tracks 36 feet south of the crossover. The top arm, a three-position signal, governs movements from the freight track to the main track, while the bottom arm governs movements to the spur track.

Movements through Union Junction interlocking are controlled by means of a 95-lever electro-pneumatic machine, manufactured by the Union Switch and Signal Company and installed about 1913, the switches and signals being operated by compressed air and controlled electrically from the levers in the machine. Normal and reverse indication magnets are installed on the switch levers, and the arrangement between magnets and segments on the levers is such that that levers cannot be moved to full normal or full reverse position until an electrical indication is received from the switch that the switch has assumed the desired position and is locked in that position. A visual indication is provided in the tower so arranged that while the switch is in the act of being moved an electric lamp is lighted, the light being extinguished when the switch has reached its full reverse or full normal position. In addition, in the event that a switch fails to operate as intended visible and audible alarms are provided to inform the operator and leverman of such failure. This latter arrangement is not provided for all switches, but switch 85, the switch involved in the accident, was so equipped. The signals are controlled from the levers but do not check the position of the switch points, as all routes through this plant were considered slow speed routes; the only locking between signal 84 and switch 85, being the usual mechanical locking.

Time table instructions restrict the speed of all trains to 12 miles per hour through Union Junction interlocking.

The weather was clear at the time of the accident, which occurred about 3:29 p.m.

Description

North-bound freight train BP-2 consisted of 86 cars and a caboose, hauled by engines 1718 and 1534, and was in charge of Conductor Fleming and Enginemen Swetnam and Palmatory. This train passed Fulton Junction, 2.2 miles south of the point of accident, at 3:16 p.m., was stopped at B.& P. Junction, departing from that point at 3:24 p.m., and passed signal 84 displaying a clear indication; however, the crossover was not in reverse position and the train entered the spur track, being derailed at the end of the spur track while traveling at a speed estimated to have been between 12 and 15 miles per hour.

The right side of the leading engine struck a caterpillar crane about 40 feet from the end of the spur track, carrying the crane along with it until it stopped in an upright position about 40 feet beyond the end of the track, with the front end of the engine headed down into an open sewer and embedded in the embankment. The tender, in reverse position, stopped along the left side of the engine. The second engine stopped on its left side diagonally across the two main tracks; its tender remained coupled and stopped across the spur track. The first three cars were derailed and tipped at various angles on the spur track. The front truck of the fourth car was also partially derailed. The employees injured were the enginemen and firemen of both engines; the other two persons injured were the crane operator and another workman in the employ of a contracting company.

Summary of evidence

Engineman Swetnam, of engine 1718, the lead engine, stated that while approaching the south portal of Union Tunnel at a speed of about 12 miles per hour he was watching signal 84, which was displaying a clear indication; when about 10 or 12 feet from the crossover he saw that it was not properly lined and immediately applied the air brakes in emergency.

Fireman Stone, of engine 1718, stated the air brakes were working properly. At Benning, where a car was picked up, his engine, which had been coupled behind the sixth or eighth car, was placed on the head end of the train, and a road test was made of the brakes which was repeated at Gwynns Run, 3.5 miles south of Baltimore, where more cars were picked up. After stopping at B. & P. Junction, where they waited several minutes for the signal to clear, they received clear indications on all the signals and he called each indication to the engineman. At approximately the time the engine reached the crossover switch he saw the engineman move to close the throttle and apply the brakes.

Engineman Palmatory, of engine 1534, the second engine, stated that the train was traveling at a speed of from 12 to 14 miles per hour and he was not working steam as Engineman Swetnam had said before leaving Potomac Yard that he wanted to go around the station slowly as he did not like Union Tunnel. He first discovered that his train was being misrouted when the fireman called him to stop and the engine gave a lurch; he applied the brakes and jumped off.

Conductor Fleming stated that before leaving Potomac Yard the air brakes were tested and were reported to be working properly; they functioned properly en route. He estimated the speed of their train at the time of the accident to have been between 10 and 15 miles per hour.

Relief Block Operator Yeagy, on duty at Union Junction tower at the time of the accident, stated that when the levers were operated to set the route from the northbound freight track to the main track through crossover 85, the warning whistle controlled

by the SS relay, and located on the second floor of the tower, sounded and the three red SS lights, two on the machine and one on the operator's table, were burning. He asked the leverman what the trouble was and called down to Megger Maintainer Debrick who was on the floor below working on switch 39 and asked if he had the circuit open on that switch and the maintainer told him that there was nothing wrong with that switch. The whistle stopped sounding but the SS lights continued to burn. He walked over to the window and saw that the signal was displaying a clear indication for the route intended. He looked over the machine with the leverman and everything appeared to be in proper condition. About that time train BP-2 was passing the tower at a speed of 15 or 18 miles per hour. Operator Yeagy understood that when the SS whistle sounded it was to notify them that something was wrong with the switch and the lamp on the lever controlling the switch that is out of order is lighted; the movement over the switch involved should then be discontinued. An emergency whistle to stop movements within the plant is also provided which should be used in the event of failure; however, Operator Yeagy stated that the light on lever 85 was not burning, and consequently he had no indication that switch 85 had not functioned properly or was out of order. He thought the SS whistle might have been sounded as a result of a test or because the maintainer was working on relays or circuits in the tower.

Leverman Miles, at Union Junction Tower, stated that after operating the levers to set the route for train BP-2 through crossover 85 the SS lights were burning and the operator asked him what was the trouble. They looked over the machine, but there was no light on the switch involved to indicate that it was out of order. He said he did not hear the SS whistle, but the SS lights continued burning. At that time there was no other movement being made in the plant. Leverman Miles further stated that as the lamp on crossover 85 was not lighted, no action was taken, although he understood that when the warning signal sounded train movements should be discontinued.

Maintainer Tracey stated that just prior to the accident he had completed his work on switch 19 and had gone to the north end of the plant to inspect switches and was on his way back from the south end of Union Tunnel, walking southward on the north-bound track, when he saw train BP-2 approaching at a speed of from 15 to 25 miles per hour. He stepped over on the spur track and on seeing that the train had entered that track he started to flag it, but he thought the engineman had already applied the brakes. He continued on down to the switch of crossover 85, found it in normal position and then went to the tower and found the lever governing that switch in reverse position. He then returned to the switch and spiked and wedged it. Maintainer Tracey further stated that while he was at the tower he did not hear the SS whistle blowing, although the three red SS lights were burning; the light on lever 85 was not burning.

Relay Inspector Shriver stated that at the time of the accident he was preparing to go off duty and was on the first floor of the tower when he heard the SS whistle sound. He reduced the pressure on the whistle to about half its volume, which is the custom when a maintainer is working on a switch, so as not to annoy the leverman. He started back where the relays are located to see what was the trouble and about that time the accident occurred. He further stated that the SS whistle had been blowing about 15 or 20 seconds when he reduced the pressure, and it could still be heard on the first floor.

Megger Maintainer Debrick, who was also on the first floor of the tower at the time of the accident, stated that when he heard the whistle blowing he called upstairs and asked the leverman what was the trouble, and on being told that they did not know, he went back to look over the relays but before he could find anything wrong the accident occurred.

Supervisor of Telegraph and Signals Spangler stated that following the accident he made an inspection and found the lever governing crossover 85 in reverse position while the crossover itself was in normal position, set for a movement to the spur track. The reverse control wire and magnets at the switches were energized with current coming into the tower from the switches on the normal indicating wire, and 85 SS polar relay in the tower was energized in the normal indicating position. There was no current on the reverse indicating wire. He said that if the lever was moved quickly from one position to the other without being stopped at the indicating point, the valves at the switch would not have time to shift, and consequently the switch would not change position. During his investigation after the accident, on releasing the reverse magnet, which was energized, and energizing the lock magnets both switches of the crossover immediately changed from normal to reverse position to correspond with the position of the lever; this was done before the lever position was changed. The crossover was then operated many times by means of the lever without displaying any tendency toward failure. Megger readings were taken of all control and indicating wires; between the switches and the tower the values were below standard but those in the tower between the polar relay and the magnets on the machine were considerably above the standard. During the operation of the crossover the reverse indicating latch, which is intended to prevent the operation of the lever from normal to reverse without stopping at the indicating point, was also watched, and it was found that the latch could be made to jump numerous times to within one-fourth the distance of the top of the tooth, and about four times it came within one one-hundredth of an inch of going over the tooth. Supervisor Spangler stated that this led him to believe that with certain conditions it would jump entirely over. He stated that his theory of the latch jumping was due to the fact that the latch was chattering slightly when riding on the surface of the segment prior to the time the safety tooth passed the under part of the latch. While the chattering was not of sufficient

intensity to cause the latch to jump over the indication tooth, it at times did strike the under part of the safety tooth with such violence as to force it downward, resulting in a rebound which caused it to jump over the indication tooth after it had passed the safety tooth. He knew of five previous instances of latches of this type having jumped when moving a lever from one position to another. The first case that came to his attention was on the Philadelphia Terminal Division in 1914, and the same condition occurred on two other levers in the same tower about one year apart. While in each case the failure could not be exactly reproduced yet the latch would so nearly go over that there was no question that if the right conditions were present it would go over. Another case was found on the B. & P. interlocking machine in 1930. He had heard of another case on the West Jersey and Seashore Railroad. During several days after the occurrence of this accident the levers in Union Junction tower were tested and attempts to reproduce the condition on lever 85 failed; however, on lever 27 the latch jumped over the top of the tooth twice during these tests.

Supervisor Spangler further stated that yearly inspections are made to determine if latches are jumping, and during the last inspection six cases were found in the two plants in the Baltimore Terminal where there was a tendency to jump and new segments were installed. After the tests following this accident the segments were removed from levers 85 and 27; they showed no apparent condition that would tend to make the latches jump; however, the safety tooth on lever 85 was slightly chipped. Supervisor Spangler stated that the signal circuits for signal 84 were not carried through the SS relay on switch 85; therefore, signal 84 could be cleared at once. In this plant none of the signal control circuits were carried through the SS relays. The special alarm circuit was installed after the failure at the B. & P. Junction plant in 1930, and instructions were issued for qualifying signalmen, operators and signal maintainers covering the operation of this circuit and setting forth the action to be taken in case of a failure. These instructions stated that if a lever in the machine is operated to a full normal or reverse position, and a crossover or pair of switch points operated from that lever is in the opposite position on the ground the whistle will blow; in such case movement should be discontinued over the switch or switches involved and the maintainer notified; he will stop whistle from sounding and note position of lever or levers causing the whistle to sound. Under no circumstances should the position of the lever or levers involved be changed until an inspection and thorough check is made of the switch or switches on the ground to see that they correspond to the position of the lever or levers in the machine. Maintainer will notify the operator concerning the results of this inspection and whether it is safe to resume movement over the switch or switches in trouble. While Supervisor Spangler considered the plant to be as safe as when it was installed, he said additional protection could be provided by the installation of SS relays on the switches which are not now equipped, and by controlling the signal cir-

circuits through the SS relays, so as to provide protection through the switch points.

Observations and tests were made by the Commission's representatives a few days after the occurrence of the accident; megger readings on circuits leading to switch 85 were lower than those made on the day of the accident; this was attributed to changed weather conditions. While these readings were below the minimum prescribed, there was no indication that this condition was the cause of the improper operation, and there was no indication of foreign current. The segment which had been in place on lever 85 had been removed on the day of the accident; this segment was replaced, but after a long period of operation, no failure resulted. Tests were continued using lever 27, and after a period of operating the lever, the latch jumped the tooth on the normal indication segment when moving from reverse to normal, the result being that the switch remained in reverse position with the lever normal. This segment was not at once removed and this action was repeated later in the day. The segment was then removed, and examination of this segment as well as the one removed from lever 85 failed to disclose any reason for its failure. Switch 27 was not provided with SS relay protection nor was it connected into the alarm circuit; therefore, the operator would have had no knowledge of its failure to operate. However, following this failure, this switch was provided with SS relay protection and connected to the alarm circuit. There were twenty switches within this plant not equipped with SS relays and none of the signals checked the position of the switch points. A careful check was made of the indication magnets on levers 85 and 27 and no indication of foreign current was found in either one, indicating that the failures were entirely mechanical.

Conclusions

This accident was caused by a false-clear indication of an interlocking signal, and by the failure of Block Operator Yeagy and Leverman Miles to take the required measures to protect movements through the interlocking plant after warning devices had been operated which indicated that some part of the plant was not functioning properly.

The investigation disclosed that a clear indication was displayed by the upper arm of interlocking signal 84; this indicated that the route was properly lined from the north-bound freight track through crossover 85 to the north-bound main track, whereas the crossover was in normal position connecting the north-bound freight track with the spur track. Neither the signal itself, nor any part of its mechanism or controlling circuits, failed; the failure was in the interlocking apparatus controlling the switches of crossover 84. When the lever controlling these switches was operated from normal to reverse the switches did not move to reverse position, due to the fact that the electrically operated latch slipped over the locking tooth on the reverse-indication segment of the machine which permitted

the lever to be moved to full reverse position without requiring a momentary stop in an intermediate position to permit the switch operating mechanism to function.

When the lever controlling these switches was reversed and the switches failed to go over, warning lights were displayed and a warning whistle was sounded. Under these circumstances the instructions required movements over the switch involved to be stopped and a thorough check to be made to see that the position of the switch or switches in the track corresponded to the position of the lever in the machine. Had this been done the condition which led to this accident would have been discovered. Instead of following the instructions which had been provided for precisely this condition, however, the leverman cleared the signal and when the operator and leverman found nothing apparently wrong in the tower they permitted the train to proceed without sounding the emergency warning whistle provided to stop movements within the plant. Had Operator Yeagy and Leverman Miles adhered to the instructions which were in effect this accident could have been averted.

The evidence indicated that while failures of interlocking from this cause occur only rarely, the railroad company was familiar with this condition and had knowledge of such conditions as far back as the year 1914. However, the only action taken to guard against the consequences of such failures was following a similar failure at B. & P. Junction tower in 1930 when an alarm circuit was developed and installed on certain switch levers in B. & P. Junction and Union Junction plants. At Union Junction interlocking plant there were sixteen levers on which the alarm circuit was installed and twenty levers which were not afforded this protection. Installation of this alarm system to provide proper protection should be extended to cover all levers in this plant.

Had the signal control circuits been arranged to check the position of the switch points, the leverman would have been prevented from giving train BP-2 a clear signal indication when the switches were not operated to reverse position. In order to insure that signals can be cleared only when the route is properly lined, signal control circuits should be arranged to check the position of switch points on the route.

Respectfully submitted,

W. P. BORLAND,

Director.