



## INTERSTATE COMMERCE COMMISSION.

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### REPORT OF THE CHIEF OF THE DIVISION OF SAFETY COVERING THE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE NASHVILLE, CHATTANOOGA & ST. LOUIS RAILWAY NEAR ROCKLEDGE, TENN., ON DECEMBER 23, 1915.

JANUARY 17, 1916.

*To the Commission:*

On December 23, 1915, there was a head-end collision between northbound passenger train first No. 2 and southbound freight train No. 55 on the Nashville, Chattanooga & St. Louis Railway near Rockledge block station, between Cowan and Sherwood, Tenn., resulting in the death of 2 employees on duty and 10 employees not on duty, and the injury of 3 passengers, 4 employees on duty, and 37 employees not on duty. After investigation as to the nature and cause of this accident, I beg to submit the following report:

On the date of the accident, regular passenger train No. 2, running from Atlanta, Ga., to Nashville, Tenn., was late. The passenger train which was involved in this accident was made up at Chattanooga. It left Chattanooga at 1.35 p. m., on the time of train No. 2, and was run as the first section of that train. It consisted of locomotive 419 and 4 coaches, and was in charge of Conductor Hancock and Engineman Reed. Train first No. 2 arrived at Sherwood at 3.36 p. m., four minutes late, met train No. 95, and departed at 3.47 p. m., having received a clear block signal indication at that point. This train had proceeded to a point approximately 4 miles north of Sherwood when, at about 3.55 p. m., it collided with train No. 55.

Southbound train No. 55, consisting of locomotive 610, 45 cars and a caboose, with Conductor Wiggs and Engineman Gribble in charge, left Nashville at 11.10 a. m., 2 hours and 30 minutes late. At Cowan, a station 3 miles north of Rockledge, two additional locomotives were attached to train No. 55 to assist it over a grade between Cowan and Rockledge. Upon its arrival at Rockledge, at about 3.45 p. m., the block operator at that point headed train No. 55 into the siding as is customary, so as to permit the helping locomotive on the head end to cut off and get into clear on a "runaway" track at the south

end of the siding. It was expected that this train would remain on the siding until the arrival of train first No. 2, but as soon as the helper locomotive was detached the helper crew noted that the dwarf signal at the south end of the siding, governing movements out on to the main line, was in the clear position, which, under the system of operation employed, authorized the movement of train No. 55 from Rockledge to Sherwood. The fireman of the helper locomotive threw the main track switch and the brakeman on this locomotive threw the "runaway" track switch. Train No. 55 passed out on to the main line at about 3.49 p. m., and had proceeded about 2 miles when it collided with train first No. 2.

At the time of the collision train first No. 2 was running at approximately 15 miles per hour, and train No. 55 was running about 10 miles per hour. Neither locomotive was derailed, and the track was not badly damaged. The first coach was telescoped by the tender of the passenger locomotive, and nearly all of those killed in the collision were riding in this coach, being colored laborers employed by the railroad company. The first two cars of the freight train were not materially damaged; the third car was derailed and otherwise damaged, while the fourth and fifth cars were practically demolished. The forward trucks of the sixth car were derailed, but the remainder of the train sustained practically no damage. The weather was mild and cloudy.

Between Rockledge and the scene of the accident the grade varies from 1.12 to 2.4 per cent, being 1.86 per cent, descending southward, at the point of the accident. The track is a series of curves with only seven short stretches of tangent. There are five cuts in this region, all of considerable depth, and the greater part of the remaining track is on embankment. Closely approaching the scene of the accident from the north there is a 4-degree curve to the east, 750 feet long, followed immediately by a curve of 3 degrees and 30 minutes to the west, 350 feet long, which in turn is followed by a 6-degree curve to the east, 950 feet long. The collision occurred at about the middle of this 6-degree curve. This series of reverse curves just described is in a rock cut, with practically vertical sides, with a maximum depth of 60 feet. The cut, which is known as "Hominy Hill Cut," is nearly 1,500 feet long.

Approaching the scene of the accident for a mile from the south there is a series of small cuts and fills; with the exception of about 1,500 feet of tangent in two sections, the alignment consists entirely of curves. Just south of the beginning of the cut in which the accident occurred there is a 6-degree curve to the west, which joins with the 6-degree curve to the east, near the center of which the accident occurred.

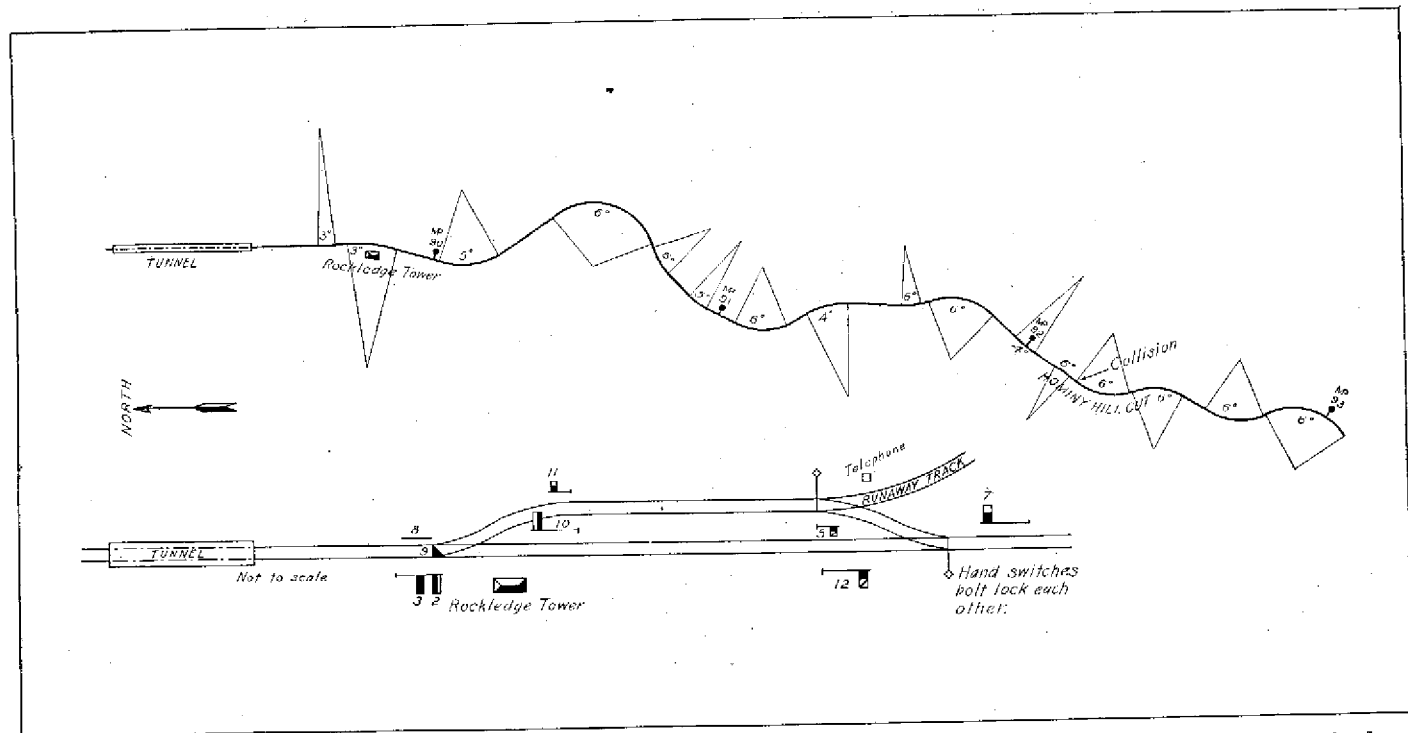
Thirty-three-foot, 90-pound rails are used in this portion of the track, with from 19 to 21 oak ties to the rail length; rock ballast is used, and the track is maintained in good condition.

Between Cowan and Sherwood, a distance of 9 miles, trains are operated under a form of the controlled manual block system, with continuous track circuits, no train orders being used. There are two block sections, one extending from Cowan to Rockledge, and the other



No. 1.—View of scene of accident, looking north, showing bent rail opposite point of collision.

from Rockledge to Sherwood. At Rockledge there is a passing siding having a capacity of 49 cars. This siding extends north of Rockledge tower nearly to the portal of a tunnel at the summit of the grade, and the southern end is around a curve and out of sight from the tower. The north end of the passing track is interlocked in the usual manner, the southbound signal at that point having two arms, one governing movements on the main line and the other governing movements into the siding. At the south end of the siding an exten-



No. 2.—Drawing showing alignment of track from Rockledge southward, and track layout at Rockledge; false clear indication given by dwarf signal No. 5..

sion is provided, running up the side of the mountain and serving as a runaway track. The switches between siding and runaway track, and siding and main line, are not controlled from the tower, but are bolt locked, so that the main track switch has to be opened first, and they must be closed in reverse order. A high semaphore signal, located to the right of the main line opposite the fouling point, serves as a block signal and is semiautomatic. It is also controlled by a switch box, so that it will not clear if the main track switch is set for the siding. A dwarf signal similarly operated governs movements from the siding to the main line and into the block. The control circuits for this signal are not cut through the switch box so that it may be cleared irrespective of the position of the switches. There is no repeater in the tower to give the operator positive information regarding the position of signals at that point. All signals used are electrically operated, of the three-position type, and giving indications in the lower right-hand quadrant. Between Rockledge and Sherwood there are one southbound and three northbound automatic spacing signals, operating in two positions only, caution and clear.

At both ends of each block special block instruments are provided which require the cooperation of signalmen at both ends of the block in order to give a train a signal permitting it to enter the block. Telephones are provided as a means of communication between block offices, and train movements are governed entirely by signal indications. At the time this accident occurred the signal maintainer for this section, a telephone lineman, in the employ of the railway company, and a gang of Western Union linemen were at work a short distance south of Rockledge transferring the pole line carrying both signal and telegraph wires to a new location farther away from the railroad track.

When train No. 55 entered the siding at Rockledge and stopped to permit the helper locomotive to cut off and go up into the "runaway" track, the rear end of the train projected out on to the main track. After the helper locomotive had pulled up into the "runaway" track the crew, observing that the dwarf signal was in the clear position, and following the customary practice, threw the switches and signaled the freight train ahead. It started out on to the main line and proceeded toward Sherwood. Previous to this time train first No. 2 had entered the block at Sherwood under a clear signal, and when train No. 55 pulled ahead the operator at Rockledge, knowing that the block was already occupied by train No. 2 and that he had not cleared the dwarf signal at the south end of the siding, supposed at first that train No. 55 was merely pulling ahead to clear the main line; but when it did not stop he realized that it was going out on the main line, and he endeavored to attract the attention of the train crew for the purpose of stopping the train. Failing in that, he tele-

phoned Sherwood, but train first No. 2 had already left that point. He then telephoned a section foreman's house between Sherwood and Rockledge, but train No. 2 had passed, and it was too late to avert the collision.

Conductor Hancock, of train first No. 2, stated that the first knowledge he had of the accident came with the shock of collision. He stated that his train received a clear signal at Sherwood. The engineman and fireman of train first No. 2 were both killed in the collision.



No. 3.—Tender of passenger locomotive, south end of cut, and reverse curve in cut where collision occurred.

Conductor Wiggs, of train No. 55, stated that upon his arrival at Rockledge he started to go to the tower, but shortly after his train had stopped on the siding it started ahead and continued out on the main line. Soon after passing the tower he started forward over the train to confer with the engineman regarding work at Sherwood and had reached a point 12 or 15 cars from the engine when the collision occurred. He stated that he saw the operator in the tower as his train passed, but at that time there was nothing to indicate that anything was wrong.

Rear Brakeman Hamrick, of train No. 55, stated that as the train was pulling out of the siding he noticed a car jumping, and went forward to find out whether there was anything wrong with it. He

stated that he found nothing out of order and went back to the rear end about the time the caboose passed the switches at the south end of Rockledge siding. He did not notice the position of the signal at that time. He stated that he rode on top of the train down to the point where it stopped at the time of the collision, then went back to flag. He did not know that a collision had occurred until a relief train came out.

Engineman Gribble, of train No. 55, stated that when his train came to a stop on the siding at Rockledge and the helper locomotive had gone into clear, he heard the helper sound the whistle signal for him



No. 4.—Looking south in cut at scene of accident.

to proceed. He asked the fireman the condition of the signal and switches, and upon being informed that the signal was clear and the switches were lined up to permit him to go out on the main track, he released the brakes and started out of the siding. He stated that the dwarf signal governing movements out on to the main line was in the clear position when he passed it, and as this signal indication gave him the absolute right to the block and there was nothing out of the ordinary in this movement he had no thought of impending danger. He did not see train first No. 2 before the collision occurred and did not remember anything that occurred after entering Hominy Hill cut until after the collision, when the fireman came to assist him out of the cab.

Fireman Gilmore, of train No. 55, stated that after the helper locomotive signaled his train to come ahead the engineman asked him the condition of the signal and switches, and as soon as they came into view he saw that the signal was clear, the switches were lined up for a movement to the main track and a man from the pusher locomotive was signaling them to come ahead. He stated that he saw the locomotive of train first No. 2 just before the collision, but he did not have time even to warn the engineman.

Head Brakeman Marshall, of train No. 55, stated that while the train was standing on the siding he got on the head car for the purpose of turning up retainers when the train started down the mountain. He saw the signal in the clear position before the train started out of the siding. He was back about eight car lengths from the locomotive when the collision occurred. He stated that he had been looking ahead, but did not see any smoke and had no intimation that train first No. 2 was approaching.

Operator Johns, at Sherwood, and Operator Christian, at Rockledge, stated that a clear signal was given to train first No. 2 in the usual manner, and the block records show that train first No. 2 entered the block at Sherwood at 3.47 p. m. Operator Johns stated that he saw the train pass the northbound signal at Sherwood and saw that signal go to danger properly after the train passed. Operator Christian stated that as train No. 55 was approaching Rockledge he learned from the dispatcher that train No. 55 should wait there for train first No. 2, and he therefore turned train No. 55 into the passing track. When the train stopped, the rear end did not clear the main line, and when the train started up soon afterwards he supposed it was pulling into clear. He started to enter the time of arrival in his block sheet, and looked at the clock, and then noting that the train was still moving he thought it was going too far. At about that time he heard a single stroke bell ring, which indicated that the head end of the train had passed out of the siding and on to the main line. He stated that he had not cleared the signal for this train, and that from the position of the levers and instruments in the tower the signals at the south end of the passing track should have been in stop position. As soon as he realized that train No. 55 was out on the main line he endeavored to attract the attention of the train crew, and then tried to stop train first No. 2 at Sherwood, and at the section house, but was unable to do so.

Engineman Kinningham, of helper locomotive 451, stated that as his locomotive passed the dwarf signal at the south end of Rockledge passing track, after cutting off from the head end of train No. 55, that signal was not entirely down to clear position and he made some remark about it to the signal maintainer who was standing near by. The signal maintainer replied that the signal was clear then and

Engineman Kinningham, looking back, saw that it was clear. He stated that the fireman and the helper threw the switches and he then signaled train No. 55 to proceed. He stated that the first intimation he had that anything was wrong was when the fireman soon afterwards went to a telephone for the purpose of obtaining instructions from the operator regarding the movement of his locomotive, and learned from the operator that he had not cleared the signal and that train first No. 2 had left Sherwood.

Fireman Miller and Helper Sargent, of locomotive 451, stated that when the helper locomotive had pulled into clear on the "runaway" track they saw that the dwarf signal was clear, and threw the switches to permit train No. 55 to proceed. They stated that ordinarily this signal returned to the stop position as soon as a train passed out of the siding onto the main line, but in this case it did not return to stop position. Fireman Miller stated that he called the attention of Maintainer Hixon to the signal standing clear after the train had gone out onto the main line.

Maintainer Hixon stated that when the helper locomotive pulled into clear on the "runaway" track he went over there to get a drink of water and the engineman told him that the signal was at caution. He stated he looked back and saw the signal was in the clear position and told the engineman that it was clear. After train No. 55 had pulled out on the main line either the fireman or the helper called to him that the signal was still clear. He stated that he ran up there, opened the high signal case, and saw that the relay in that case, controlling the dwarf signal, was energized. He shunted the coils of this relay, and its armature dropped, the signal going to danger position; he removed the shunt and the signal cleared up about halfway and then went back to danger. At about this time he learned from the fireman of the helper locomotive that the operator had not cleared the dwarf signal for train No. 55 and that train first No. 2 had left Sherwood, and he then realized that this signal had given a false clear indication to train No. 55. As that train had gone, and he could do nothing to stop it, he immediately started to make an examination of the signal and telegraph wires, for the purpose of ascertaining the cause of the false clear-signal indication. Western Union linemen were at work at this point transferring wires and pole line to a new location farther away from the track, and the signal maintainer, assisted by a lineman, was transferring the signal wires to the new pole line. As this pole line is located on the outside of a curve at this point it was necessary to lengthen the wires by "cutting in slack," and at the time this false clear signal occurred there were some bare joints in the signal wires. Near this location, also, a pile of old ties had some time before been burned under the wires, charring the insulation on the signal wires. Maintainer Hixon

stated that he did not find any cross between the signal wires which might have caused this signal to indicate clear improperly, and while he did not see any of the Western Union telegraph wires in contact with the railway company's signal wires at that time, it was his opinion that the relay controlling the dwarf signal must have been energized by foreign current, and he thought this foreign current must have come from a cross with one of the Western Union telegraph wires at the place where the signal-wire insulation had been damaged by fire. He stated that a day or two after the accident occurred he found two places where guy wires were touching the railroad company's common wire extending from Sherwood to Rockledge. This caused a heavy ground, and he stated that with this condition, if a cross occurred between a Western Union telegraph wire and the control wire for the dwarf signal at the south end of Rockledge passing track, the signal would clear up.

Maintainer Hixon and Signal Engineer Pflasterer stated that on the day following the accident tests were made by crossing the dwarf signal control wire with other signal wires, and with the Western Union telegraph wires. They stated the cross with the other signal wires had no effect on the signal, but that the signal cleared twice when crosses were established between this control wire and one of the Western Union telegraph wires. They also stated that shortly after the accident occurred they made an examination of an interlocking relay located about halfway between Rockledge and Sherwood; the position of the armatures of this relay demonstrated beyond question that train first No. 2 entered the block at Sherwood before train No. 55 entered the block at Rockledge.

In statements of the Western Union linemen who were at Rockledge at the time of the accident it was brought out that, at the point north of Sherwood where the ground on the signal common wire was found after the accident had occurred, some of the guy anchors had not been moved when the poles were moved back, but the guy wires had simply been lengthened out and attached to the same anchors at their original locations. At the time this work was completed none of the guy wires was in contact with any of the railroad signal wires, but afterwards rocks dumped by a railroad construction gang had fallen upon two of these guy wires, forcing them down and into contact with one of the signal wires. It was also stated that particular care was exercised in transferring the pole line and wires to the new location to prevent any contact or cross between telegraph and railroad signal wires, positive statements being made that no such cross occurred.

This accident was caused by a false clear indication of the dwarf signal at the south end of the passing track at Rockledge, due to foreign current.

The investigation of this accident establishes the fact that the relay controlling this dwarf signal was energized by current which came from some source external to the normal control circuit. But at the time this false clear signal occurred it was not determined where this current did come from, and as it is now impossible to duplicate exactly the conditions then existing, it is impossible to determine positively the source of this current. The fact is established that the signal common wire between Rockledge and Sherwood was grounded. This condition was not discovered until after the accident occurred, but the records of work disclose that it must have existed at the time of the accident. When the signal maintainer discovered these grounds on the common wire he unfastened this wire from the insulators and moved it back on the cross arms to a position out of contact with the guy wires. During investigation of this accident tests were made on December 28 to demonstrate whether or not the dwarf signal could be cleared by crossing the control wire for the dwarf signal with Western Union telegraph wires and also with other signal wires. The ground connection to the common wire was restored. The crosses established between the control wire and other signal wires had no effect on the signals, but the dwarf signal was cleared when crosses were made between its control wire and each of 12 of the Western Union telegraph wires.

Tests were made to ascertain whether or not the track rails carried any foreign current; these tests failed to disclose the presence of any foreign current in the rails. It is apparent from an examination of the signal wiring diagram that by introducing certain combinations of crosses and grounds it would be possible to obtain sufficient power from one or more of the railroad company's other signal batteries to clear the dwarf signal, but no tests were made to demonstrate this, as there was no evidence to show that such crosses or grounds did exist at the time of the accident.

At the time of this false clear signal indication there was considerable disarrangement of both signal wires and telegraph wires. Several of the signal wires had been removed from the poles, the insulation had been taken off at certain points, and slack had been cut in preparatory to transferring them to the new location. The joints in these wires had not yet been taped up and the wires were sagging down from the poles which had not yet been moved; some of them were either lying on the ground or hanging a short distance above the ground. The signal wires leading from the pole line to the signals had also been lengthened and these wires were lying on the ground near the base of the pole opposite the signal location, which pole had not been moved; the joints in these wires had not yet been taped. The signal maintainer stated that when he examined the signal wires after the false clear signal was discovered he failed to find any cross be-

tween them, or any bare joints touching. Western Union telegraph linemen stated, however, that the signal wires were lying on the ground badly tangled up, and that later when the wires were put up on the pole line it required some little time to get them straightened out and arranged in their proper places.

In moving the pole line the Western Union wires were detached from alternate poles; these poles were then taken down and set in their new locations. The wires were then transferred from the poles in the former line to the poles which had been set in the new line. The telegraph wires were no doubt sagging down somewhat for two pole lengths in the old line, but the evidence is that only one telegraph wire was transferred at a time and the necessary slack was cut in at the time this wire was moved over to the new pole line, the acting foreman himself letting off the wire gradually as it was moved over, and making the joint before removing the blocks. He stated that in view of the conditions existing at the time, it was impossible for the telegraph wires to get into contact with the signal wires, for the reason that slack had been cut in the signal wires, and except where they rested on the crossarms they sagged down a distance of 14 or 15 feet below the telegraph wires. However, the signal maintainer stated that in the evening following the accident, after the Western Union men had left their work for the night, he found three or four of the Western Union wires in contact with the railroad company's signal wires near a junction pole where the signal wires did not sag down very far, and it was near this point that the insulation on the signal wires had been damaged by fire.

On the night of December 28 the same dwarf signal which gave the false clear indication leading to this accident remained in the clear position after a southbound train left the siding. The cause was later discovered to be a cross of wires in a temporary lead-encased cable leading to the northbound spacing signal, a short distance south of the interlocking relay; this probably caused the signal battery to be crossed with a wire leading to the interlocking relay, holding that relay energized when it should have been deenergized owing to the position of the southbound train. A careful investigation, both of the plans and on the ground, leads to the conclusion that this cross could have had no bearing on the accident on the 23d, for the reason that the track conditions and the conditions of signal apparatus in the block towers were quite different at the time of the accident from those that existed at the time of the signal failure on the 28th.

In this connection it is noted that men were working on the Western Union wires at the time of the occurrence of the false clear signal which caused the accident; the lineman in the employ of the railroad company, who had been assigned to assist Maintainer Hixon, was at that time also working on Western Union wires. The conditions

which caused the signal to clear up soon disappeared, and in the meantime the signal wires evidently were not touched or disturbed. It does not appear that in this case the signal wires were handled any differently than is frequently done in work of this character, although probably no great care was taken to prevent crosses or grounds in the signal wires when they were being transferred to the new pole line. On account of the nature of signal circuits, however, it is not necessary to exercise as great care in handling wires of this kind as with telegraph or telephone wires.

This is the first accident that has been investigated and, in fact, the only one reported since the commission's accident investigation work was begun which is positively known to have been caused by a false clear block signal indication. It is known that signals do sometimes give clear indications improperly, but there are very few occurrences of this kind—only a very small fraction of 1 per cent of the total number of signal operations—and accidents caused by such false clear signal indications are exceedingly rare and infrequent. In general, signal circuits are so designed that a single cross, ground, or other abnormal condition among the signal wires themselves will not cause signals to clear up or remain clear improperly. The dangers from foreign current, however, are well recognized. Stray ground currents may follow the rails of railroad tracks for considerable distances and hold track relays energized improperly. In localities where trouble from this cause is particularly likely to occur, as for example where there are many electric railway lines, many railroad companies have installed alternating current signal apparatus, which is less likely to be affected by foreign current. The danger of a cross between signal-line wires and other wires used for the transmission of power or for telegraphy, or wires carrying current for electric lighting, is always present, and as much of the railroad signal apparatus in common use is normally operated by comparatively low voltages, sufficient current would be supplied by a cross with any of these wires to operate signals. Insulated wires are ordinarily used for signal circuits, and on some railroads signal wires are run on separate pole lines to reduce the liability of crosses with other wires. But even these precautions do not remove all danger of crosses, as they may occur at pole line crossings; the insulation is not intended for high voltages and it may become worn or stripped off, leaving line wires exposed, without interfering with the normal operation of the system.

The installation of signal apparatus and circuits on this line between Cowan and Sherwood appears complicated, but while it includes some special features not ordinarily found in installations of the controlled manual block system, the circuits appear in general to be well designed and to provide for most contingencies of operation.

This signal installation is more or less isolated. In view of its location, even the best modern signal engineering practice would not call for the use of alternating current apparatus or any other special precautions against foreign current. More complete protection would have been provided in this particular situation if the main track switch at the south end of Rockledge passing track was controlled from the tower, and in that event this accident would probably have been averted.

Respectfully submitted.

H. W. BELNAP,  
*Chief, Division of Safety.*

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