INTERSTATE COMMERCE COMMISSION

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE LINE OF THE KEY SYSTEM TRANSIT COMPANY AT OAKLAND, CALIF, DECEMBER 4, 1924

JANUARY 12, 1925

TO THE COMMISSION

On December 4, 1924, there was a rear-end collision between a passenger train of the Key System Transit Company and a passenger train of the San Francisco-Sacramento Railroad on the line of the Key System Transit Company at Oakland, Calif, which resulted in the death of 8 passengers and 2 employees off duty, and the injury of 36 passengers and 2 employees The investigation of this accident was conducted jointly with the Railroad Commission of the State of California

LOCATION AND METHOD OF OPERATION

The Key System Transit line is an electric railway using 600 volts direct current for propulsion purposes, it comprises street-car lines in Oakland and other cities in the East Bay district, and the Key Division, on which this accident occurred, on which trains are operated from junction points with the street-car lines to the Key System Pier Terminal, located 3 85 miles west of San Pablo Avenue, Oakland At the pier connections are made with ferryboats which are operated to Market Street, San Francisco In order to reduce the number of train unit operations on the Key Division it is the practice to consolidate trains in each direction between junction points and the Pier Terminal and the trains on this division consist of from one to as many as eight cars Trains of the San Francisco-Sacramento Railroad are also operated over the Key System tracks from Fortieth Street and Shafter Avenue to the Pier Terminal The operation of these trains between those points is under the supervision and control of the Key System Transit Company

That part of the Key System line on which this accident occurred is located upon a fill extending into San Francisco Bay It is a double-track line equipped with an automatic block-signal system combined with an automatic train-stop system The signals are of

the three-position, upper-quadrant type and the automatic train stop is of the overhead mechanical trip type Alternating current control circuits and single-rail track circuits are used The signals are mounted on center trolley poles and the automatic stop arm is connected to the spectacle casting of each signal and operates simultaneously therewith When the signal is in the danger position the stop arm is in position to engage the arm of a valve located on the car roof Should the car pass a signal and a stop arm in this position the valve is automatically operated to cause an emergency application of the air brakes In the vicinity of the point of accident trolley poles are spaced 105 feet apart and signals and

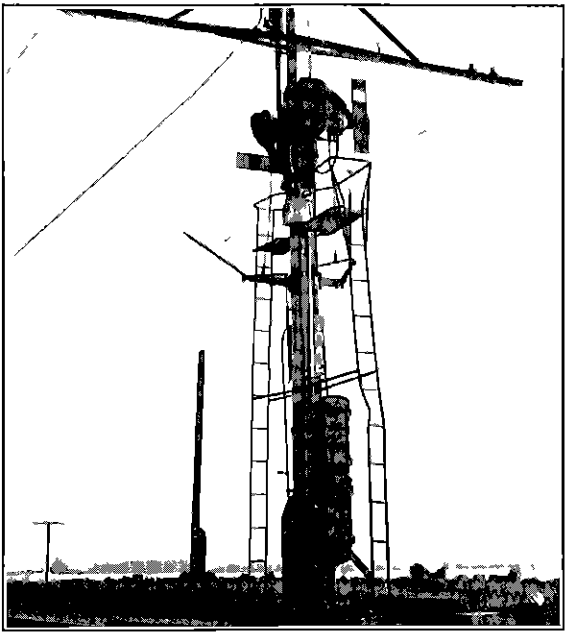
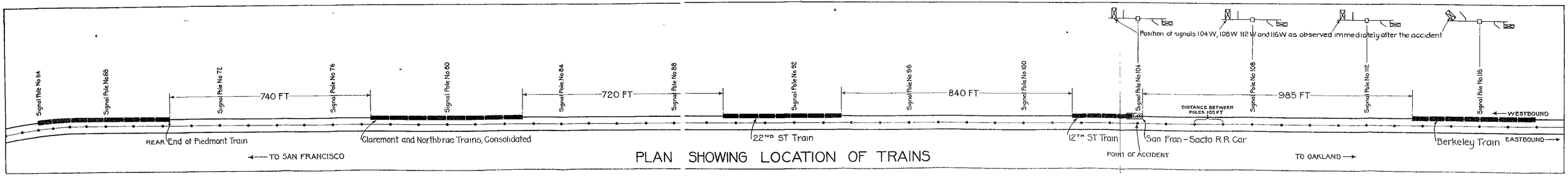


FIG 1—Signal pole 104 looking eastward Eastbound signal in clear position westbound signal at stop, with automatic stop arm extended

automatic stops are installed on each fourth pole, or 420 feet apart A full-block overlap is provided by the control circuits, which are arranged to display one caution and two stop signals behind each train The arrangement of signals in this vicinity is intended to provide for the movement of trains under a headway of 45 seconds and was designed to provide adequate braking distance for Key System trains which with the propulsion current used are operated at a maximum speed of approximately 36 miles an hour and at this speed require a distance of from 300 to 350 feet in which to stop

Signal 104 is located 11,321 feet west of signal 46 at tower No 2 Approaching the point of accident from signal 46 the track is tan-



PLAN SHOWING LOCATION OF TRAINS

gent for a distance of 6,197 feet, then there is a 30′ curve to the right 633.72 feet in length, followed by 4,491 feet of tangent to signal 104, the tangent extending a considerable distance beyond that signal. The accident occurred practically opposite signal 104, located at a point about 1⅛ miles east of the Pier Terminal, at about 7.54 a. m.

At the time of this accident a light rain was falling and the range of clear vision was limited to a distance of approximately one-half mile.

DESCRIPTION

The trains involved in this accident were Key System westbound train No. 729 and San Francisco-Sacramento westbound train No. 15. Train No. 729 was a consolidated train of the Oakland Twelfth Street line and consisted of four center entrance motor cars, Nos. 655, 656, 664 and 665 in the order named, with Conductor Noone and Motorman Compton in charge. The motorman of this train received a caution signal indication at signal 104 on account of preceding trains being delayed due to switching operations at the Pier Terminal. Approaching this signal Motorman Compton shut off power and when about opposite pole 106 applied the brakes for the purpose of bringing his train to a stop, the train stopped with the head end some distance east of signal 100, which was in the stop position, and the rear end practically opposite signal 104. While standing at this point the rear end of this train was struck by San Francisco-Sacramento train No. 15.

San Francisco-Sacramento train No. 15 consisted of motor car 1014 and was in charge of Conductor Knoblock and Motorman Brubaker, this train was en route from Concord, Calif., to Oakland Pier Terminal. The last stop made prior to the accident was at tower No. 2 on the Key Division, where it was stopped at signal 46 and held until two Key System trains had proceeded toward the pier. After train No. 729 had cleared, the route was lined up for train No. 15, that train then proceeded toward the pier and while running at an estimated speed of about 20 miles an hour collided with the rear end of Key System train No. 729, which was standing near signal 104.

Motor car 1014 telescoped the rear car of train No. 729 for a distance of 18½ feet. It came to a stop with the head end of car 1014 at a point 37 feet west of signal 104, and the rear end of car 665, the last car of train No. 729, was 18 feet 6 inches west of signal 104.

Car 665 was constructed with steel underframe, steel side frame and steel body plates, having wooden lining and wooden roof construction. It was 57 feet 7½ inches long, weighed 60,000 pounds, and the distance from top of rail to top of 8-inch buffer beam was

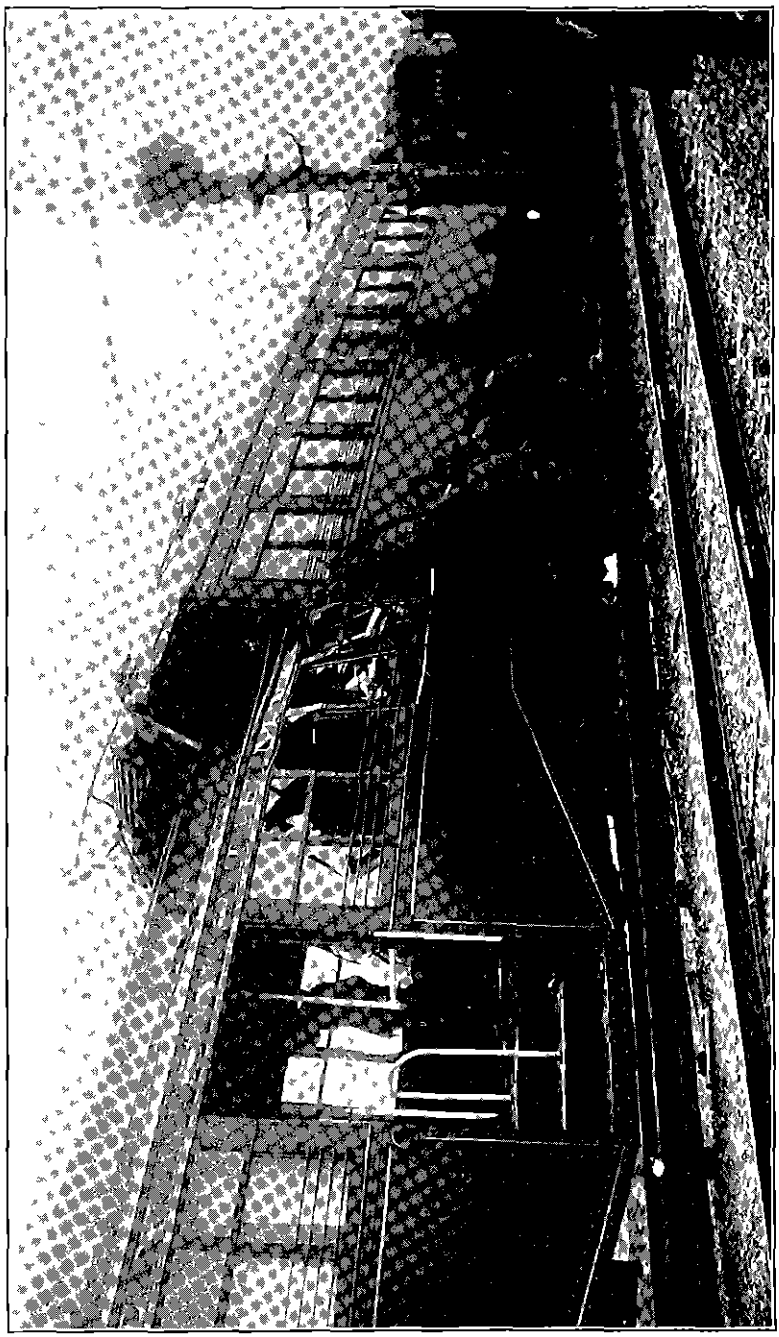


FIG 2—Key System car 665 telescoped by car 1014, signal pole 104 opposite car 1014

48 inches. The rear portion of this car was practically demolished, the damage probably being due in part, at least, to the fact that the floor line and top of the body buffers were lower than the floor and buffers on the San Francisco-Sacramento car. Motor car 1014 was of steel-underframe construction, having wooden superstructure. It was 57 feet 10 inches long, weighed 93,260 pounds, and the distance from top of rail to top of 8-inch buffer beam was 53 inches. The platform of this car overrode the floor of the Key System car. The forward end of car 1014 and a partition 7 feet from the head end were demolished, pipe connections and other equipment broken or torn from the car, and the truck on the damaged end was driven

FIG. 3.—Interior of car 665 after separation from car 1014.

backward about 10 feet, bending foundation brake gear rods and causing other damage. The leading pair of wheels of this truck was derailed.

SUMMARY OF EVIDENCE

The employees injured were Motorman Brubaker and Conductor Knoblock, of train No. 15. Motorman Brubaker, on advice of counsel, refused to testify and declined to give a statement of any character, on the ground that anything he might say could be used against him in criminal proceedings which were thought to be pending.

Motorman Compton, of train No. 729, stated that on the morning of the accident there was a light rain but the view was good. When he

had reached a point practically opposite signal 108, he saw that signal 104 was in the caution position, he shut off power, made a full service application of the air brakes, and had no difficulty in bringing his train to a stop before reaching signal 100, which was in stop position He stated he immediately sounded a whistle signal for the flagman to go back and then released the brakes, within 30 or 35 seconds after stopping he felt the shock of the impact, which moved his train forward a distance of 3 to 4 feet Motorman Compton said the head end of his train stopped at a point about 130 feet east of signal 100 and he thought the rear end cleared signal 104 by a few feet He stated the reason he stopped at that distance from signal 100 was because he made a full service application in order to be certain that his train would not pass the signal, and had he released so as to approach nearer to it before stopping he probably would have overrun the signal In making this stop he stated that he shut off power as soon as he saw the caution signal, at which time he was running at full speed, and made a brake application at about the second pole east of the caution signal

Conductor Noone, of train No 729, stated that approaching the point where the accident occurred his train was running at a speed of from 30 to 35 miles an hour, and that it came to a stop with the rear end extending slightly east of signal 104 He was in the rear car of his train As soon as the train stopped the motorman sounded the whistle signal for the flagman to go back, he took up flagging equipment, got out the center door on the left-hand side of the car and started back, but the collision occurred before he reached the rear end of his train and without his having seen the approaching train

Brakeman Hamma, of train No 729, stated that when his train stopped near signal 100 he was collecting fares in the leading car of the train He estimated the time of impact at about 30 seconds after his train came to a stop

Brakeman Van Dalsen of train No 729, was in the third car from the head end, and had finished collecting fares He also estimated that the shock of collision came about 30 seconds after the train came to a stop, and thought his train was moved forward a distance of about 4 feet

Motorman Hobson, who was deadheading on train No 729, was riding in the motorman's compartment of the third car from the head end He stated that as soon as the train stopped Motorman Compton sounded the whistle signal for the flagman to go back, he raised the cab window and on looking toward the rear saw train No 15 about two car lengths from the rear of train No 729, moving at a speed which he estimated to be about 30 miles an hour He

realized at once that a collision was unavoidable and as there was not sufficient time to get out he braced himself and waited for the shock of impact

Conductor Knoblock, of train No 15, stated that from Concord to Fortieth Street, Oakland, his train consisted of two cars, at the latter point the rear car was cut off and they proceeded toward the Pier Terminal with one car, which was in good operating condition Their train was stopped at tower No 2 because of signal 46 being set against them, and he saw train No 729 leave that point, his own train following about 1½ minutes later He stated his train made the usual speed between tower No 2 and the point of accident and he did not see train No 729 after leaving the tower until just before the collision occurred Approaching the point of accident the motorman made a service application of the brakes, which was followed very closely by an emergency application due to the automatic train stop valve arm striking the trip arm operated in connection with the signal He heard the exhaust of air from the automatic stop valve and the emergency application of the brakes resulting therefrom threw him off his balance He then looked forward and saw the rear of train No 729 only about two-car lengths ahead Conductor Knoblock estimated that when the service application was made by the motorman the speed of his train was from 35 to 40 miles an hour, and he thought that perhaps 30 seconds elapsed before the emergency application occurred After the emergency application he thought the brakes locked the wheels as the car seemed to slide forward until the impact of collision came Conductor Knoblock stated that Motorman Brubaker operated train No 15 from Rock Ridge to the point of accident he had no conversation with the motorman except a word or two when he got on the train at Rock Ridge, but there was nothing out of the ordinary in connection with the operation of the train between Rock Ridge and the point of accident

Motorman Willis, of the train which followed train No 15 westward from tower No 2 on the morning of the accident, stated that he operated his train under clear signals at a speed of about 30 miles per hour He stated his range of vision extended for at least half a mile, and after passing through the subway under the Southern Pacific Railroad west of tower No 2, train No 15 was constantly in view until the time of the accident He thought that train was running at a higher rate of speed than he was able to attain

Motormen on other trains which were being operated over this line on the morning of the accident stated that the rain did not obscure signals and that, although the rails were wet, they had no difficulty in properly controlling and stopping their trains in accordance with signal indications

Towerman Corker, who was on duty at tower No 2, stated that when train No 15 arrived at his tower it was held about one minute to allow train No 729 to leave in its regular turn Train No 15 left tower No 2 as soon as the switches were lined up for its route, the signal cleared, and the flagman recalled, which he thought was about 45 seconds after the departure of train No 729 No exact record of the time of departure of trains from that point is kept

Electrical Engineer Bell, of the Key System Transit Company, stated that the signal circuits are so arranged that when a train receives a clear signal indication the signal remains in clear position until the last pair of wheels passes the insulated joint in the track located practically opposite the signal The purpose of this arrangement is to prevent the signal and automatic stop arm from assuming the danger position until the arms of the automatic stop valves on all cars in the train have passed the signal He stated that the body of a Key System car overhangs the rear axle a distance of about 7 feet 6 inches and that the insulated joint at signal 104 is located 4 feet 6 inches west of the trolley pole on which this signal is mounted Assuming that train No 729 stopped with its rear axle just clearing the insulated joint at signal 104 there would be two stop signals displayed, signal 104, located practically at the rear end of the train, and the other, signal 108, 420 feet in rear of it, a caution indication would be displayed by signal 112, 840 feet from the rear of the train Mr Bell reached the scene of the accident at about 9 or 9 15 a m, and found that the rear end of train No 729 after the collision was standing 18 feet 6 inches west of the center line of pole 104 The automatic stop arm of signal 108 clearly showed that it had been struck by an automatic stop valve arm, the mark being very fresh, and he removed this arm in order to preserve this evidence Examination of the valve arm of car 1014 also showed a fresh mark indicating that it had been in contact with the automatic stop arm Except for the removal and replacement of the automatic stop arm on pole 104 nothing had been done to the signal and automatic stop apparatus prior to the investigation and it had functioned properly both before and after the accident Mr Bell stated that the signal system had been placed in service in 1911, and that there are approximately 18,000,000 forty-five degree movements throughout each year During the entire time the system has been in service only four false clear failures have been reported, the last of which occurred in 1916

Master Mechanic Jackson, of the Key System Transit Company, stated that he arrived at the scene of the accident about one hour after it occurred, while considerable damage to equipment had resulted from the collision, examination disclosed nothing which would indicate that the brakes had failed to operate properly prior to the accident He stated that the channel iron buffer on car 665 was not

overridden by the buffer on car 1014 but was driven back over the top of the center sills, at the same time pulling in the side angle-iron sills which prevented the sides of the car from being fanned outward by the telescoping action.

Superintendent Thornton, of the Key System, stated that on the morning of the accident trains were being operated in their proper order. Just prior to the time of the accident switching operations at the Pier Terminal required approaching trains to be stopped and there were two trains preceding train No. 729 which were stopped and held for that reason. He stated that he instructs train-service employees of the San Francisco-Sacramento Railroad as to their duties on the Key Division and all motormen understand that they are required to operate their trains under clear signals and that the speed of trains is dependent upon the distance of clear vision. He stated that he impresses upon all employees the importance of observing what is ahead of them and the fact that the responsibility in case of accident rests upon the motorman of the following car. He had not had any trouble with Motorman Brubaker on this line except once before, on March 1, 1922, when he was involved in a rear-end collision.

General Manager Mitchell of the San Francisco-Sacramento Railroad stated that the operating agreement between his railroad and the Key System Transit Company provides that all equipment, train crews and passengers while on the tracks of the Key System Transit Company are entirely under the control of and governed by the rules and regulations of the Key System Transit Company and officers thereof. New employees of the San Francisco-Sacramento Railroad are required to report to officials of the Key System Transit Company for examination and instructions before they are qualified for service.

Superintendent of Electric Equipment Miller of the San Francisco-Sacramento Railroad stated that cars of the type of car 1014 are so geared that they can attain a maximum speed of 55 miles an hour when operated by a propulsion current of 600 volts. After the accident the automatic stop valve was removed from car 1014 and installed for test purposes on a similar car, No. 1012. The result of tests in each case was that the brakes were applied and brake-cylinder pressure of 55 pounds was obtained, the initial brake-pipe pressure being 70 pounds, after each test a period of from 38 to 73 seconds was required for the brakes to release.

Examination of car 1014 indicated that prior to the collision the brakes locked the wheels and caused them to slide along the rails as all eight wheels on the car showed flat spots of from 1 inch to 1¼ inches in length.

ANALYSIS OF EVIDENCE

It is noted from the statement of Motorman Compton, of train No 729 that he shut off power when he first observed signal 104 in caution position and in order to bring his train to a stop made a full service brake application when at about pole 106 He estimated that the head end of his train came to a stop about 130 feet east of signal 100 However, in view of the length of train No 729 and the position of the rear end of the last car after the collision, it appears that the head end of train No 729 came to a stop approximately 185 feet east of signal 100 and that therefore a distance of 430 or 440 feet was required to make this stop

The evidence clearly established the fact that the signal system operated properly That signal 108 was in the stop position at the time train No 15 passed it is conclusively established by reason of the fact that the automatic stop valve arm engaged the trip arm operated by that signal

The evidence also establishes the fact that the automatic stop apparatus functioned to cause an automatic application of the brakes when train No 15 passed signal 108, the first stop signal which it encountered when approaching the preceding train The very purpose of the automatic stop system which was in service on this line is to prevent accidents of this character, and the failure of the automatic stop system to prevent the accident in this case was due to the fact, first, that train No 729 came to a stop at a point which resulted in the minimum braking distance afforded by the automatic train stop devices being provided, and, secondly, that train No 15 was being operated at a rate of speed which required greater braking distance than the minimum provided by the automatic stop system, a further contributing factor was that the rails were wet and the wheels locked and slid after the brakes were applied by the operation of the automatic stop device

The minimum braking distance provided by the automatic stop system was based upon tests with cars capable of attaining a maximum speed of 36 miles an hour Train No 15 consisted of a car capable of attaining a maximum speed of 55 miles an hour According to the statement of the conductor of this train, the speed at the time the automatic stop device was operated was approximately 35 or 40 miles an hour In view of the fact that after the brake applications made by the motorman and by the automatic train-stop device the car ran a distance of more than 400 feet, and collided with the preceding train at a rate of speed variously estimated at from 20 to 30 miles an hour, the force of impact causing considerable damage to substantially constructed cars, it is apparent that the speed of this

can materially exceeded 36 miles an hour, the maximum speed provided for by the automatic train-stop system installed on this line.

Rules governing the operation of trains under automatic block signals on this line provide that proper operation is "to run at an even speed on a clear or proceed signal, which is the normal position of such signal." The rules also provide that a caution signal "means proceed with caution prepared to stop at the next signal." It is apparent from this investigation that Motorman Brubaker failed to comply with these rules and to control his train as required by caution and stop signals displayed for his train. There is no evidence that the signals were obscured by rain, but on the contrary there is direct testimony from a number of motormen who were operating trains on this line at the time of the accident that the signal indications could clearly be seen for considerable distances. In view of the refusal of Motorman Brubaker to furnish any statement in the matter, no explanation of his failure to observe and obey caution and stop signals can be advanced.

On the portion of the line where this accident occurred there is no rule prescribing a maximum speed limit.

CONCLUSIONS

This accident was caused by the failure of Motorman Brubaker to operate his train in accordance with the requirements of existing rules and to observe or obey automatic block-signal indications, also by reason of the fact that trains were operated, and were permitted to be operated at speeds which required greater distance in which to bring them to a stop than the minimum braking distance provided by the automatic stop system as installed on this line.

To provide against a recurrence of an accident of this character, the Key System Transit Company should at once establish a maximum speed restriction for all trains operated over this line, which will insure that any train can be stopped in the minimum braking distance provided by the automatic stop system.

All of the employees involved in this accident were experienced men and none of them was on duty in violation of any provisions of the hours-of-service law.

Respectfully submitted.

W. P. BORLAND,
Director.

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