

Park City, Ogden and all other outside stations in order to complete the metallic circuit. The more wires that parallel each other, the less inductive influence will be felt by each wire.

CHARLES BROWN,

manager of the Western Union Telegraph Office in this city testified that he was acquainted with the effects of an overhead electric car line in Council Bluffs. He said the telephones were not rendered entirely useless but that it was very difficult to use them, many subscribers threatening to take out their instruments. He had been in the central office of the telephone company and noticed the annunciators drop when a car passed under a telephone wire and diagonally to it.

A deposition was then offered in testimony by the prosecution from

E. B. FIELD,

general manager of the Colorado Telephone Company at Denver, stating the difficulties encountered from the electric car line which was in use fifteen months in that city.

Objections were made to taking this as evidence because there was no mention made of the system used there, after which court adjourned to 10 o'clock a. m. July 21 when the case was adjourned.

C. D. VAILE

was the first witness, of the telephone company; testified that in his opinion the telephone service would be interfered with; if the wires were to touch the instruments would be burned out.

To Mr. Rawlins—I think a 500 volt current would not kill, but would produce an unpleasant shock; I think there would be danger to our linemen from the street car feed wire; to get any shock he would have to touch two wires to complete the circuit; I know of no accident of the kind; the Denver road complained of had an electric current of 3000 volts; in that case it was an underground wire; that is different to the system here; we remedied the interference with the telephone wire by putting up return wires; we had no false calls; I am not an electrician, but am acquainted with the practical working of the telephone system; in stringing a wire, and passing it over the bracket holding the street car feed wire, there would be danger to the employees; our men use rubber gloves, but I would not trust any insulation.

The affidavits from Denver, offered previously were admitted in evidence. These affidavits recited instances where electric light and electric cable wires had caused annoyance to the telephone systems. The reading of these affidavits took up most of the morning session.

C. F. ANNETT,

manager of the telephone company, testified that he had been associated with electric systems over 25 years; had been a telegraph operator till six years ago; our service here is

more satisfactory than in most eastern cities; we have interference from telegraph lines where they parallel ours any distance.

To Mr. Rawlins—When on the Union Pacific, when we had 350 to 400 volts, one wire interfered with the other about 1-16 of the time where they were parallel for several hundred miles.

Two articles in the *Electrical Review* were introduced in evidence and the plaintiff rested.

THE DEFENSE

opened by introducing its grant of a franchise by the city, the amendments thereto, and the articles of association, and court took recess.

The first witness for the defense was

F. P. LEWIS,

who testified that he was the electrical engineer of the Sprague company, and had received class instructions in electricity, and had been engaged in the experimental department, of the Sprague company for eighteen months, since which time he had been out on the road establishing car lines for that company. The first line put in at Richmond was in 1887, and consisted of sixteen miles of track and fifty cars, since which time forty more cars have been ordered, and the track extended eighteen miles. Originally they put in a return wire, which was afterward abandoned as useless, and a ground used instead. At the time the system was first put in, I presume there was at least five times as much loss as at present, it now not being over two per cent. The system has gradually been perfected and I think that now no improvements of importance will be made for at least ten years. In Boston there are twelve miles of double track of the Sprague system and sixteen of the Thomson-Houston. When I left New York there were fifty-four roads including those in operation and those for which material had been ordered. Since the Sprague system has been introduced, they have not made a single failure. The system to be constructed in this city will consist, at first, of seven and one-half miles of track which will be operated by a No. 32 Edison dynamo, and the current is to be carried by a feeder, consisting of a thoroughly insulated No. 2 soft copper wire. The covering is made of hemp string, shalac and asphaltum, which constitute the best insulation known. This feeder runs parallel with the trolley wire and taps it every 600 feet; this is done so that if the line should break it would not be dead along the entire length. The current passes from the trolley wire through the car and to the rails and ground. The maximum voltage of the line will be 500, while at a distance of from one to one and a half miles it will be 400 or 450 volts. The trolley wire is constantly charged, being connected with the feeder. The instant the car reaches a point where the connection is broken on the rail, it produces a flash and the car jerks as though it had struck a snag. There is no danger from the

rails or wire as I have received shocks from it more than one hundred times and I think a man could not be killed by it; of course it would shake him up considerably. The current is in the rail only when the car is directly over it. In order to test the injurious effects it would have on persons and stock crossing the track I applied a galvanometer, which showed no indication of electricity, and afterward put my tongue to the rail and found no sensation. In New York there is one car running by the storage battery system, but as this requires a central office in every car and an experienced electrician to run it, besides adding \$3000 to the cost of each car, it will not become popular, at least not until some important inventions have been made in storage batteries. The double trolley or metallic circuit was the first system we tried, but it has never been successfully operated. One of that kind is in operation in Pittsburgh, but we now have a contract to replace it with the Sprague system. From my knowledge, and from the fact that the Sprague system has nearly the double number of lines in operation of any other company, and starting after them, I think we have the most perfect system in existence. The Thompson-Houston system is similar to ours, and there are now several cases in court contesting the rights of the two companies, and it is only a matter of time when one or the other will be compelled to cease operations. Everywhere I go I hear of trouble with the telephone companies. At first it was laid to induction and later to a loss of current. This was remedied by Mr. McClure, whom I am acquainted with, by putting in a return ground for the telephone lines. I think it impossible to have induction where the wires are ten or even more feet apart. If the telephone company and car line both grounded on the water pipes, there might be a chance of interference, but if they used the water pipes and we grounded in a well or by plates, there would be no chance for interference. In every case where there have been difficulties we have remedied them, that is, we assisted the telephone company to make these changes, in every case it has been without expense to us. The only damage I know of would be in case the telephone wires dropped on our wire, the former would be burned in two. I know of a case of this kind occurring in Richmond, when a storm blew down the wires. The electricity might go to the switch board in the central office, but would cause no fire. Empty cars can be taken over the track in this city at the rate of twenty miles an hour and loaded cars will travel twelve miles an hour. I have observed the relative position of the two systems of wires and I think there is no danger in handling the wire, which should be done with rubber gloves and insulated pliers and connectors. In order to get a shock, it is necessary to have connection with the trolley wire and the ground. In order to throw an an-