down the valve stem until it engages the retaining nut. This securely seats the valve, and prevents the entry of any gas until needed. When the cams on the lay or two-to-one shaft open the inlet valve, the balanced piston and valve move together.

This engine has been used two seasons and has done excellent service. It has been found extremely economical in air used for starting. The engine is a marvel of simplicity as to its air-starting arrangements.

The Art Machine Company, of Brooklyn, N. Y., had two exhibits. On the main floor were seen sectional and full models of the Fulton engine, celebrated two years ago by being selected as the motive power in the widely known Knickerbocker Yacht Club one-design power-boat class, or "Sea Skunks." One of these craft was shown complete in every detail, reduced to one-quarter size.

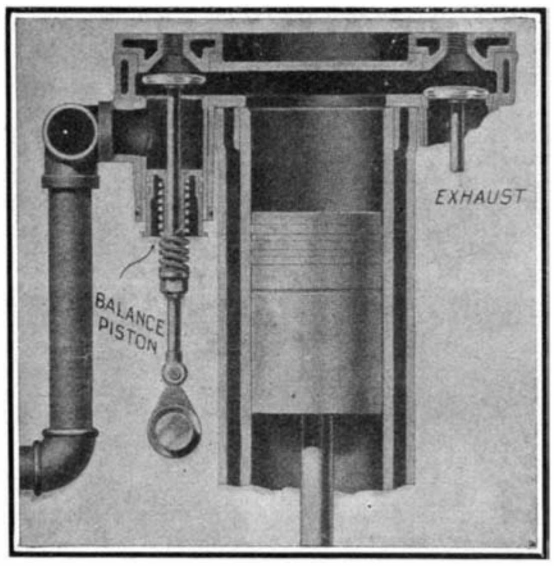
In the gallery was shown an economical electric soldering iron, connected with an ammeter and voltmeter. It showed a consumption quite remarkable. An iron equivalent to a 4-pound regular copper took 2⅛ amperes of a 116-volt current, while a larger size, equivalent to a 6-pound copper, took but ⅛ ampere more.

Showing that heavy-duty engines are in demand, the Buffalo Gasolene Motor Company, which has heretofore built only high-speed engines, has placed on the market a line of their slow-speed heavy-duty machines, one of which was exhibited.

Altogether, there were three high-powered engines exhibited. One was the 300-horse-power, double-acting "Standard," which, together with the boat that it drove last autumn a mile in record time, was illustrated in the Motor Boat number.

Another was a 250-horse-power engine, built by James Craig, Jr., of this city. This is the type of engine used in Holland submarines, such use necessitating a light, strong engine. The third was the 150-horse-power "Speedway," manufactured by the Gas Engine and Power Co. and Chas. L. Seabury & Co., Consolidated.

One of our illustrations shows this engine. It is of the usual four-cycle type and is made up of six cylinders, having an 8½-inch bore by 10-inch stroke. Its power rating is at 550 R. P. M., and it is capable of being speeded up somewhat, and developing still more power for high-speed work. The valve arrangement is similar to that used heretofore. In addition to the high-tension ignition system (the current for which is supplied from a storage battery and a small dynamo that charges the same), low-tension magneto ignition is also fitted. The make-and-break igniters are seen in the valve chambers of the six cylinders. They are operated by rods extending downward to a special igniter cam shaft, which is placed beside the usual half-speed cam shaft and driven from it by gears. The mechanism is such as to give a very quick break at the igniters. A Sims-Bosch low-tension magneto is driven from the ignition cam shaft, and hence its armature is always kept in the proper relation with the breaking point of the igniters. The engine is provided with a governor, which closes the throttle and keeps the engine from racing when the clutch is thrown out. The cylinders and wrist pins are lubricated by a force-feed oiler, and the main bearings and crank pins by a gravity-feed oiler. The crank pins are furnished with centrifugal oil rings. The cylinders are mounted upon cast box-shaped sections, each of which is bolted to the bed plate of the engine. The engine is cooled by water circulated through the cylinder jackets by means of a gear-driven gear pump. The water first passes through the cylinder jackets, entering on the exhaust side; it then passes through outside connections leading from the upper part of the cylinder jacket to the cylinder heads (which are removable), and finally passes around the water-jacketed exhaust pipe. The engine is started by means of compressed air, which is let into three of the cylinders. The air is obtained under pressure by means of a small compressor driven by the engine. It is stored in a small reservoir under a pressure of 60 pounds to the square inch. The carbureter is located above the engine in an accessible position. It is of the overflow type, being supplied by a small plunger pump worked by the engine. The inlet pipe and the carbureter are heated by the exhaust gases of the engine, which pass through suitable jackets around them.

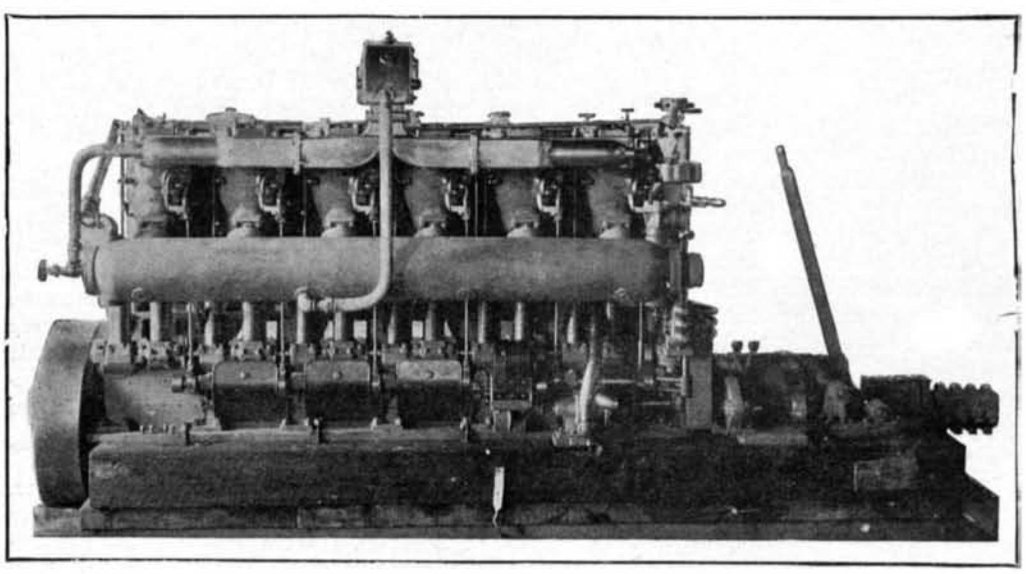


Cylinder of Dock Engine, Showing Inlet Valve Carried in a Balanced Piston.

The Holmes 25-horse-power four-cylinder four-cycle auto marine engine, built by the Holmes Motor Company, of West Mystic, Conn., attracted considerable favorable comment. This is the engine that stood the severe test at the hands of the U. S. life saving service officials recently, on Lake Michigan. It is an especially get-at-able engine, and has made a record for facility and speed in assembling and disassembling.

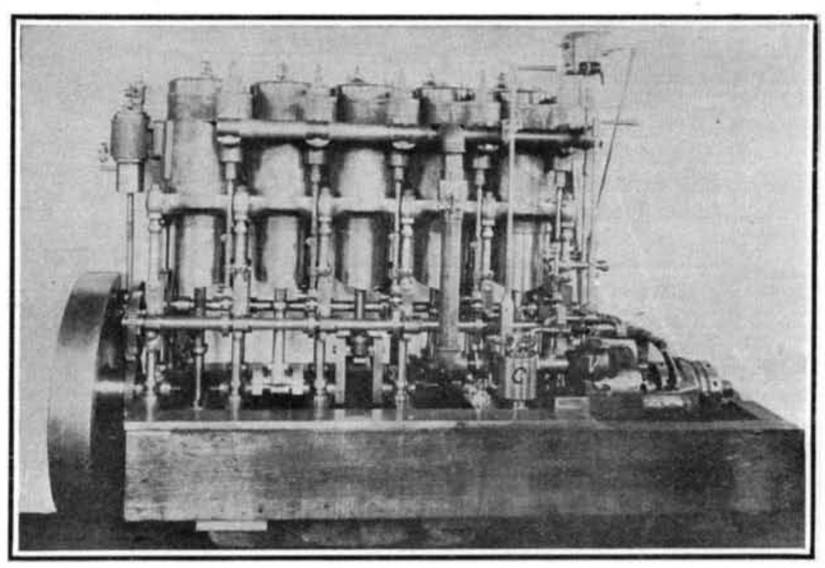
The attendance during the show was good. There was not present the morbidly curious crowd which has been in evidence in previous years, and the attention of would-be purchasers has not been continually diverted by aquatic and other scheduled events.

Another year it is hoped that uniformity of decorations and signs will be followed and that the spaces will be more evenly divided, which will be necessitated, provided many, who should exhibit, decide to take part in next year's Show.



Exhaust Side of the 6-Cylinder, 150-Horse-Power Speedway Marine Engine.

Cylinder bore and stroke, 8½ x 10. Normal speed, 550 R. P. M. The special features of this engine are the separate igniter camshaft and the water jacketed exhaust.



Inlet Side of the 5-Cylinder Dock Marine Engine.

Cylinder bore and stroke, 5 x 8. Normal speed, 450 R. P. M. This engine has a special air starting device of great simplicity.

NOVEL MARINE GASOLINE ENGINES ON EXHIBITION AT THE MOTOR BOAT SHOW.

WRECK OF AN ELECTRIC TRAIN ON THE NEW YORK CENTRAL.

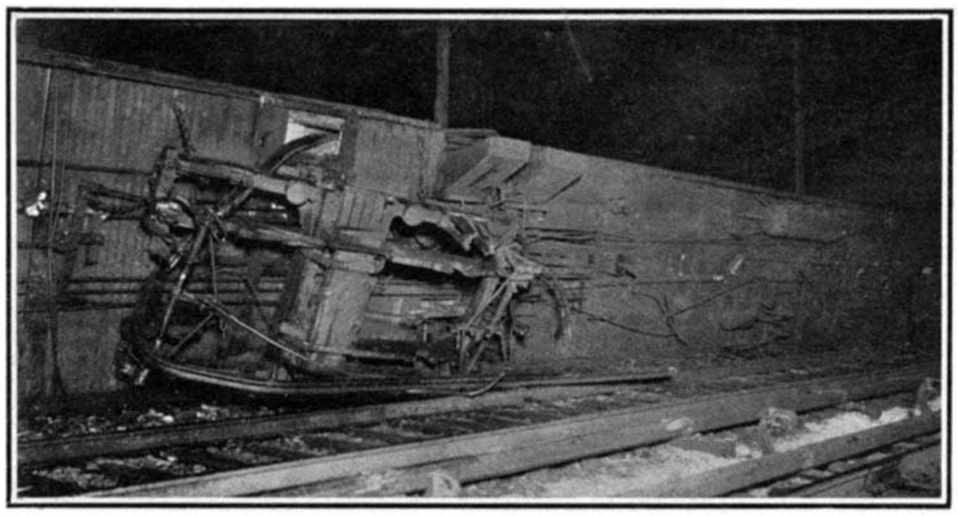
In addition to the sympathy which we feel for those who suffered in the recent derailment wreck on the New York Central Railroad, when twenty-three persons lost their lives and a large number received more or less injury, every one who is not blinded by prejudice must also feel sympathy for the railroad company that the inauguration of their costly and most excellent system of electric operation should have been darkened by this terrible tragedy. It is not for us to prejudge the case, but it certainly does seem that the worst that can be said against the management is that they failed to realize that even their splendid roadbed, whose reputation is known the world over, required some further adjustment to meet the heavier stresses incidental to the operation of electric locomotives. If our foresight were always as clear as our hindsight, accidents of this character would never happen. We believe that, as a body, engineers of the high professional training of those employed by our leading railroads are marked by great zeal and thorough conscientiousness in their work. But the history of engineering shows that when new problems are presented, it is seldom that the analysis of conditions grasps every new element and makes adequate provision therefor.

To take the case in point, the curve on which the accident occurred was an easy one, being of only three degrees variation from a tangent in every 100 feet of length. It called for a 4½-inch elevation of the outside rail, and under these conditions the centrifugal force would be about balanced on a train running at the speed of 46 miles an hour. At speeds above this the train would crowd against the outside rail with a pressure which would increase as the square of the velocity, and in the judgment of the engineers this speed could be run up to as high as 65 miles an hour without endangering the train. This, they claim, is the general railroad practice throughout the country. Now the reason that steam railroad tracks are not elevated for the highest speed is that slow trains are sometimes run over express tracks, and it is considered that the best compromise is to elevate the outside rails for the mean speed.

The elevation of the outer rail above the inside rail is done in obedience to Newton's first law of motion, according to which a body will continue in its state of uniform motion in a straight line unless compelled to alter that state by force impressed upon it. Thus, when a train enters a curve, its tendency under this law is to continue to run in a straight line, and the "force impressed upon it" is represented by the reaction of the outside rail of the curve, which thrusts the train laterally from the straight line, with a pressure which increases directly in proportion to the weight of the train, in the inverse proportion to the radius of the curve, and directly as the square of the velocity with which the train is moving. This product of the weight, speed, and curvature is known as the centrifugal force; and when a train is running on a curve which has no elevation of the outer rail, a point is soon reached at which the resultant of the weight of the train acting vertically and the centrifugal force acting horizontally, will pass outside of the outer rail and result in the overturning of the train, or the climbing of the wheels over the track, a condition which is represented in one of the accompanying engravings. In order to counteract the lateral centrifugal effect, the outer rail is elevated and the car tilted toward the inside of the curve. If this elevation is of just the right amount for the sharpness of the curve and the speed of the train, the resultant of the weight and the centrifugal force will lie in a direction normal to the track, and the train will have no disposition to bear against either the outer rail or the inner rail. If the elevation is too small for the speed and curvature, the train will bear against the outer rail, and if the elevation is too great, the train will tend to bear against the inner rail.

Now, since the accidents due to jumping the track or the spreading of the rails always occur on the outer rails, it is evident that it would be better to have an excess of elevation rather than otherwise, thus relieving the outer rail, even when the fastest expresses are running around the curve, and permitting the slower trains to run against the inner rail, against which there is but slight risk of derailment. It is true that because of the action of the coning of the wheels, the resistance of the slower trains may be somewhat increased by this arrangement; but the increase would not be sufficient to counteract the enormous advantage derived from having an absolutely safe-riding track.

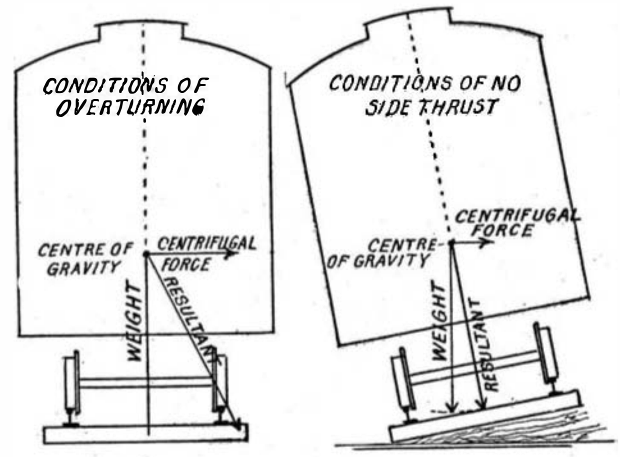
In the case of the accident on the New York Central, an inspection of the curve on the morning after the accident, when the track had been once more put in shape, showed that the spikes on the outside of the outer rail at the point of derailment had been neatly sheared off between the outer edge of the base of the rail and the tie-plates. Opposite the commencement of this rail, the ties on the inside of the curve were scored, while those on the outside were intact; which is clear proof that the outer wheels remained on the displaced rail, and jumped the track at the end of it, where the scoring of the ties on that side begins to be visible.



Bottom View of One of the Overturned Cars, Showing a Length of Third Rail Wrapped Around the Truck and Driven up Through the Bottom of the Car. Another View of This Rail Shown in Cut Below.

The train was made up of two 95-ton electric locomotives, followed by a combination baggage and smoker car and four ordinary day coaches. The weight of the two motors was about 190 tons and of the five cars about 200 tons. The condition of the track after the accident, the scoring on the ties made by the derailed wheels, and the fact that the two locomotives did not leave the rails, would indicate that the outer rail was driven out of place by the locomotives as they swept along the curve, and that as the cars reached the same rail they left the track, and tore through the adjoining third rail (which was stripped from its place and in some places wrapped around the trucks and even driven up through the cars, as shown in one of the accompanying illustrations), the cars finally overturning and sliding along upon their sides until their momentum was expended. It was during this last period that the fatalities occurred; for the passengers, being thrown against and through the broken windows on the lower side, were ground between the cars and the tracks as between the upper and the nether millstone.

The fact that for many years steam locomotives, heavier than these electric locomotives, have been hauling heavier trains than this one around these curves at speeds which were frequently between 60 and 70 miles an hour, without the occurrence of any accident of this kind, naturally points to the conclusion that there must have been something in the conditions on this train which produced heavier lateral stresses upon the outside rail than occur on steam-operated trains. If this be so, these conditions must lie in the locomotives, for the train was a light one. Why should these electric locomotives exert a heavier, or, rather, a more destructive, thrust against the rail than do the steam locomotives? The answer will be found in the accompanying diagram showing the two locomotives, from which it will be observed that 69 tons of the weight, being on the drivers, is concentrated within a space of 12 feet, and that the whole 95 tons weight of each locomotive is concentrated upon a single rail length and the whole 190 tons weight of the two locomotives upon two rails' length. Although this is not a heavier average per foot, and, indeed, not so heavy, as that of some of the steam locomotives, it is



Approximate Diagrams, Showing the Effect of No Elevation and Full Elevation Upon the Stability of Trains on Curves.

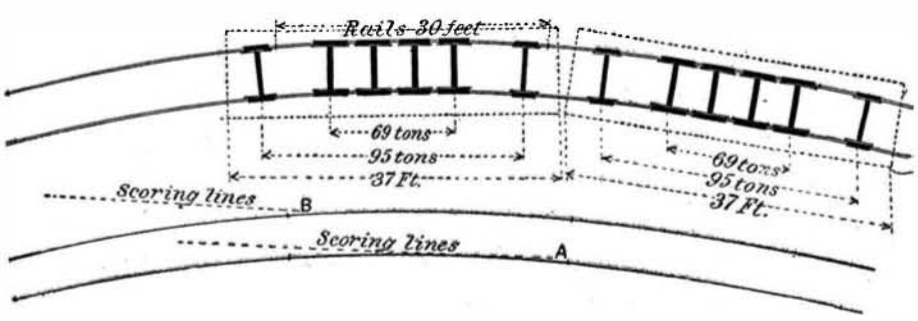
much heavier, considered in its centrifugal effect against the outer rail; for the leading and trailing pairs of wheels are arranged to swing radially and give to the curvature. Hence, the main lateral thrust of these engines must be concentrated at the rigid wheel base represented by the four closely-assembled driving wheels. This effect is aggravated by the fact that the center of gravity of the four heavy motors, which are arranged concentrically around the axles, must lie at the center of these axles, or only 21 inches above the track. Consequently, the impact or surging of the locomotives against the outer rail must act with a much greater hammering effect than does the weight of a steam locomotive, which acts through a center of gravity which is much higher above the rails.

An inspection of the new rail, after the tracks were cleared up, suggested that there was a slight flattening of the curve at this point; that is to say, that the line of this rail lay somewhat inside of the true curvature. If this were so, it must follow that when the rigid group of four drivers on the first motor struck the rail, its natural effort would be to iron out the flat spot, as it were, and that it was in the effort to do this that the spikes on the outside were sheared off in succession as the motors swept by, and the whole rail pushed over into the position shown in one of our illustrations.

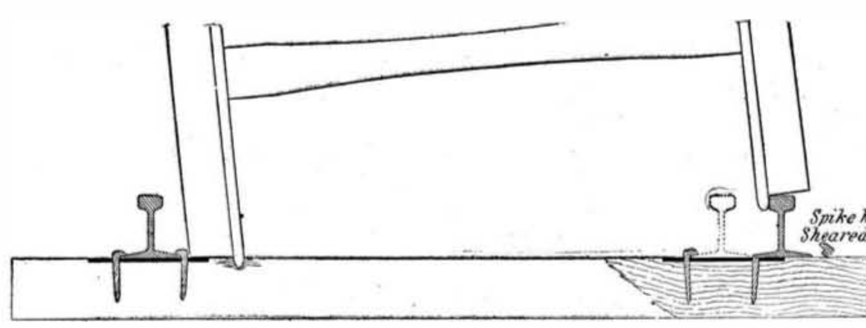
Now that electric locomotives are being introduced on steam railroads, we believe that special attention must be given to the question of maintaining curves at their proper alinement and elevation. Every maintenance-of-way engineer knows that the traffic tends to throw the curve out in both of these respects. For such service, it would be a good policy to elevate on curves for the maximum speed. Moreover, for the guidance of trackmen, it would be an excellent and not very expensive provision to place stone or iron bench marks and centers at every 100 feet around such curves; for these, being permanent, would give the trackmen a constant and reliable reference mark, and would obviate the necessity for their dependence upon the occasional visit of the engineer with his transit and level.

The Resin Content of Jalap.

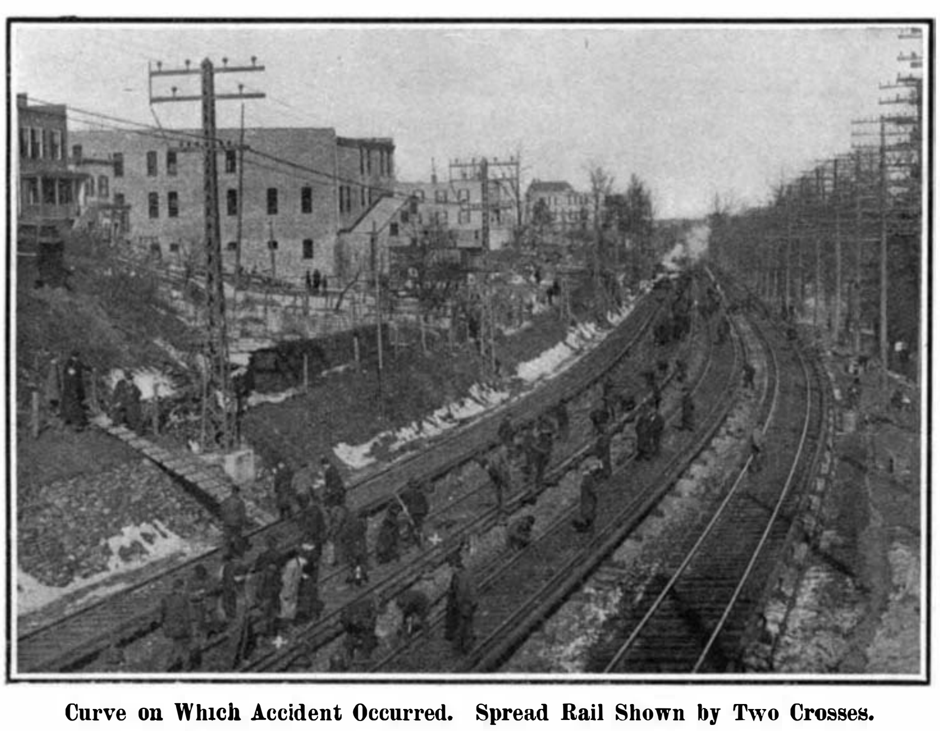
R. W. Moore (Journ. Soc. Chem. Ind.) has determined the resin content of 276 samples of jalap. The figures ranged from 15.63 per cent down to 2.10, the average for the lot being 5.95. Only twenty-six sample contained as much as 9.0 per cent of resin. The author remarks that the jalap imported into the United States is of extremely variable character, and much difference exists in packages from the same lot.



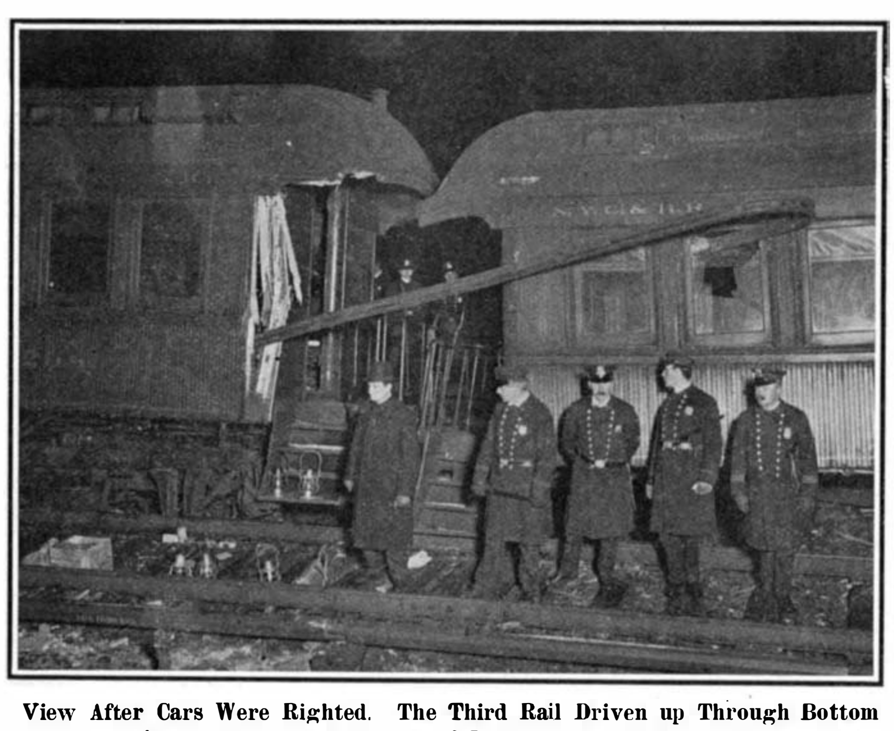
Upper Diagram Shows Relation of Weights and Length of Locomotives to Length of Rails Lower Diagram Shows Scoring of Ties at Point Where Outer Rail Was Spread.



Sectional View Showing How the Side Thrust Caused Outer Rail to Shear Off Spike Heads Between Edge of Rail Base and Edge of Hole in Tie Plate.



Curve on Which Accident Occurred. Spread Rail Shown by Two Crosses.



View After Cars Were Righted. The Third Rail Driven up Through Bottom and Side Post of First Car and Into Window of Second Car.

WRECK OF AN ELECTRIC TRAIN ON THE NEW YORK CENTRAL RAILROAD.