### PRESSED-STEEL SYSTEM OF CAR CONSTRUCTION.

In the early days of railroads in the East, wood was used almost exclusively as the material of framed structures. Not merely the trestle viaducts, but even the important long-span bridges were constructed of timber. Half a century ago this was a matter of necessity, and to-day, on western roads, it is still one of economy. With the growth of the steel industry and the great cheapening of iron and steel structural shapes, it was only a question of time before these wooden bridges would be replaced by more serviceable and safe metal structures, and as the country opened up by the pioneer railroads in the West is being settled and its resources developed, the same substitution of steel for wood is taking place.

Strange to say, although the use of iron and steel in the construction of the rolling stock of the railroads was advocated and experimentally attempted nearly half a century ago, it is only within the last three or four years that the steel car has been able to assert its superiority over wooden railroad cars, and thereby bring within measurable distance the time when, at least for the transportation of freight, all-steel rolling stock will be exclusively used. The same arguments which favored the introduction of steel bridges, steel ships, and skeleton-steel buildings, are now operating to produce a revolution in the freight car business, which is one of the most remarkable economic facts in the field of transportation. Briefly stated, the argument from a structural standpoint is based upon the fact that, although a cubic foot of southern yellow pine or Oregon pine when built into the car will average about 50 pounds in weight as against a weight per cubic foot of steel of 490 pounds, the maximum strain allowed in calculating the necessary section of the various members of a wooden freight car is only 1,100 pounds to the square inch, as against a unit of stress allowed in the case of steel of 13,000 pounds per square inch; figures which show a theoretical superiority weight for weight of steel over wood, say of about 20 per cent. This saving would apply only to such parts of a car as were subjected to direct tension or compression. Seventy-five per cent of the material in the car acts as a beam, however, and is subjected to transverse strains; and here the saving of weight, strength for strength, will amount to about 9 per cent. Hence it is estimated that the theoretical saving of weight on the whole car is about 11 per cent. In making the connections and joints of the steel parts, however, there is not so much sacrifice of materials as in a wooden car; and this 11 per cent advantage must, therefore, be increased proportionately. Moreover, it is safe to say that, in a comparison of two cars of the same carrying capacity and strength, the "factor of safety" will be found to be larger in the steel car than in the earlier type.

What is suggested by theory is proved by actual facts; for in a wooden car of 30,000 pounds weight empty, and 60,000 pounds carrying-capacity, the ratio of the load to the total weight of car when loaded is 66.67 per cent; whereas in a pressed-steel car of 80,000 pounds capacity, weighing 28,500 pounds, the ratio of load to total weight when loaded is 73.75 per cent; while in the case of a pressed-steel ore car of 100,000 pounds capacity, weighing 28,000 pounds, the ratio of load to total weight when loaded is about 78.1 per cent. Another and valuable advantage of the pressed-steel car is that its life is probably double that of the wooden car. It was officially reported by the Western Railway of France, in the year 1897, that steel cars built in 1869 had lost only 6 per cent of their weight by corrosion in an interval of twenty-eight years.

As a result of the reduction of the dead-weight of the car there are many numerous advantages to which the roads that have adopted the new system refer in justification of their policy. Thus, the capacity of the individual car being increased, a reduced number of cars is required to haul a given amount of freight. From this it follows that there is a reduced amount of empty-car hauling to be done, and a reduced amount of switching service. The train-length is shorter, and hence it is easier to back trains into sidings and otherwise handle them in the various yards of the roads. There is also a reduced payment for car mileage and cost of inspection; and, lastly, there is a decrease in the cost of repairs from an average of say $35 to $40 per annum for the wooden car to an average, as proved by reports received from the railroad companies, of from $10 to $15 for the steel car. We have before us an interesting comparison given by Mr. Von Z. Loss in a paper read before the International Railroad Congress, Paris, last year, showing the comparative earnings of wooden and pressed-steel cars operating under average conditions of service in the United States. The figures are worked out on a basis of costs and earnings per ton per mile on an assumed yearly mileage of 5,000 miles loaded and 5,000 miles empty. The cost per ton per mile of both live and dead weights is assumed at 3 mills, and the gross earnings per ton per mile of freight in the Eastern States of America at 6 mills. Of 1,000 pressed-steel gondola cars, recently figured on against specifications for wooden gondolas of 80,000 pounds capacity, the wooden car weighed 18.2 tons and was of 82,000 pounds of coal capacity. The steel car weighed 16.1 tons, and had a capacity of 86,200 pounds of coal. In the case of the wooden car the yearly income from lading hauled 5,000 miles at the given rate amounted to $1,230. The cost of hauling the lading was $615, and the cost of hauling the dead weight $546; so the net earnings for the year of the wooden car amounted to $69. In the case of the pressed-steel car the yearly income from lading amounted to $1,293. The cost of hauling the lading amounted to $646.50; the cost of hauling the dead-weight amounted to $483, the net earnings of the steel car per year working out as $163.50, or $94.50 in excess of those of the wooden car. Hence, it was shown, the increased earning capacity of the car during its life of thirty years would be $2,835, and the increased earning capacity of 1,000 steel cars over 1,000 wooden cars during a life of thirty years would be $2,835,000. It is estimated, in the paper above referred to, that the average capacity of the existing wooden cars in the United States is about 25 tons, and that the total capacity of all wooden cars in the United States is 37,500,000 tons. From this it is figured that on the basis of an average annual mileage per car of 3,500 miles, and an average cost per ton per mile of 3 mills and average gross earnings of 8 mills, the total yearly profit from all wooden cars is $215,000,000. If the above-mentioned lading of 37,500,000 tons were to be concentrated in large capacity, pressed-steel cars, the total dead-weight would be cut down from 21,000,000 tons to 14,000,000 tons, which would represent a hauling expense saving of 147,000,000 tons. Of course the above figures are given merely in a general way for comparison, and must not be applied too literally, for the reason that there must be certain localities where the conditions of railroad service, and the nature of the freight to be carried, would not favor the use of large-capacity cars; but even if the statement be largely modified by this consideration, the argument is still enormously strong in favor of the new system of construction.

That the above estimate of the economies realized by the use of steel cars is not exaggerated is rendered likely by the remarkable popularity which they have achieved with the railroad companies. Although the first pressed-steel car was built as late as 1897, the industry has grown at such a rate that at the beginning of the present year there were 46,000 pressed-steel cars in use, and at the present time about 10,000 men are employed at the four different works of the Pressed-Steel Car Company in turning out new cars at the rate of over a hundred per day. The two largest factories are located at McKee's Rocks and at Allegheny, at each of which works over 4,000 men are employed. There are also two smaller works at Joliet and Pittsburg, each employing about 600 men. Of the two larger concerns, the one at Allegheny is the older. In spite of the frequent enlargement of the latter establishment during the past three years, it was found necessary to purchase new ground at McKee's Rocks and erect an entirely new plant to accommodate the rapidly increasing business.

The steel used in the manufacture of the cars is what is known as medium-soft Carnegie, with an ultimate strength of 60,000 pounds to the square inch, and an elongation of 25 per cent in 8 inches, with a reduction of area of 50 per cent. The buildings are laid out with a view to a minimum amount of handling of the material, which moves from shop to shop in a regular sequence of operations, until it is hauled out on the tracks from the paint shop in trains of finished cars, to be taken to the various railroads of the country. At the date of our visit to these works in March, 1901, cars were being finished at the rate of 106 per day.

The stock, in the shape of plate steel, is first marked out with templates and sheared to the finished size. It then undergoes either Heavy Pressing or Light Pressing. The larger pieces, such as longitudinal car sills for the under-framing, and also such pieces as require but slight forming in the presses, are pressed cold; and one realizes what an economy in labor there is in the manufacture of these cars in seeing how rapidly the side sills, many of them 40 feet in length, are pressed into shape, the work being done in three strokes of the hydraulic press. The first stroke brings up the center of the sill where its section is deepest, and two more strokes serve to bring up the shallower ends. As a matter of fact, the whole operation of forming side sills of the largest dimensions occupied only one and a quarter minutes. The smaller and more complicated pieces, which are more difficult to bring up to shape, are first heated in the furnace to a bright cherry red, and then subjected to light pressing in a smaller hydraulic press.

After pressing, the parts are taken to the construction department, where the work is almost entirely one of drilling and riveting, the work of the presses being of such accuracy as to involve a minimum amount of fitting. As much of the machine-riveting as possible is done in the Construction Department, and the material is then passed on to the Erecting Department, where the cars are put together, and such hand-riveting done upon them as is necessary. Here the draft-gear and brakes are put in as ordered, each Road having its own special preference as to type and pattern. In the erecting shop there are four aisles with series of parallel tracks extending down them. Upon these the cars are erected. The axles come to the tracks rough-turned, where they are finished and put upon the wheels by hydraulic pressure.

One of the first items undertaken in the direction of pressed-steel car construction was the pressed-steel bolsters for trucks. As shown in our engraving, these are built as box girders, in a form which offers great resistance to vertical and lateral distortion. Then followed the pressed-steel truck, of which we show two types; one, the Fox Pedestal Truck, which is specially suited to first class roadbeds, and the other the Pressed-Steel Diamond Truck, which affords greater horizontal flexibility and is suited to roads with less carefully aligned and surfaced track. Our other illustrations show some of the types of car which are to-day in successful operation.

### Electrical Notes.

A company has been formed to manufacture the new storage battery invented by Thomas A. Edison, which will be known as the Edison Storage Battery Company. The new company will proceed at once to enlarge the factory of Mr. Edison at Glen Ridge.

It is said that negotiations are in progress with the Western Union Telegraph Company for the adoption of the Rowland multiplex-telegraph printing invention. The machine has been brought to a high state of efficiency, and the heirs of Prof. Rowland and business men of Baltimore have organized what is known as the Rowland Company.

A correspondent of The Electrical World writes that while in the Western Union office at Reno, Nev., recently, he noticed a very pronounced hum above the noise of the instruments. Upon inquiry he was informed that the Blue Lakes Power Company was testing its line and that this inductive effect was the result. It was also stated that the line was at the time being experimentally tested at 85,000 volts, the line being about 170 miles distant from Reno. The noise, which was most disagreeable, would rise to a certain pitch and then fall to a lower pitch as if the generator was racing.

The first installation of Marconi's wireless telegraph system upon an Atlantic liner has been placed upon the Beaver steamship "Lake Champlain." When the vessel left Liverpool, owing to the great interest that was manifested in the innovation, arrangements were made at several parts of the coast for receiving messages from the vessel as she proceeded on her journey. Communication was first opened with the wireless telegraph station at Holyhead when the steamer was thirteen miles distant, and was maintained until thirty-seven miles separated the vessel from the station. Several of the passengers availed themselves of the opportunity to telegraph to their friends in all parts of the United Kingdom, each message being acknowledged from the receiving station and then dispatched to its destination over the government wires. The experiments were highly satisfactory, and the other vessels of this line will be similarly equipped with the apparatus as soon as possible. When the various steamships of the other transatlantic companies are fitted with the apparatus, it will be possible for the passengers to be kept posted in the progress of the world, even in mid-ocean, since the news will be telegraphed from ship to ship.

A new underground rapid transit electric railway is being projected in London. It will stretch from Piccadilly along the Strand, Fleet Street, Ludgate Hill, to the City. By this means travel through the busiest artery of the metropolis will be considerably facilitated. It is proposed to take the line beneath a narrow street in the immediate vicinity of St. Paul's Cathedral, and great apprehension is felt that the excavations will seriously impair the foundations upon which the sacred edifice stands. The soil beneath Ludgate Hill and the surrounding neighborhood is composed for the most part of loose gravel and sand. The Dean and Chapter of the cathedral fear that any excavation would tend to drain off the underground water. The cathedral itself rests upon a tremendous bed of concrete. Should the underground water be tapped there is a liability of this concrete bed cracking in all directions, in which event the safety of the edifice would be severely menaced. A settlement of the building, it is considered, would be inevitable. The Central London Railway in its passage through Cheapside passes beneath the church of St. Mary le Bow—another of Wren's buildings—and through the settlement of the building the spire has been thrown 23 inches out of the perpendicular.

# SCIENTIFIC AMERICAN

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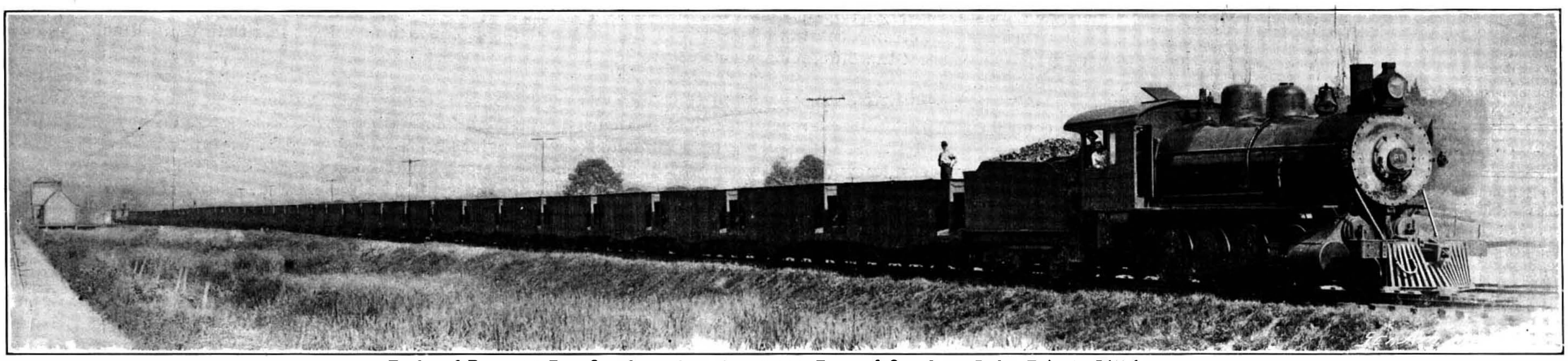
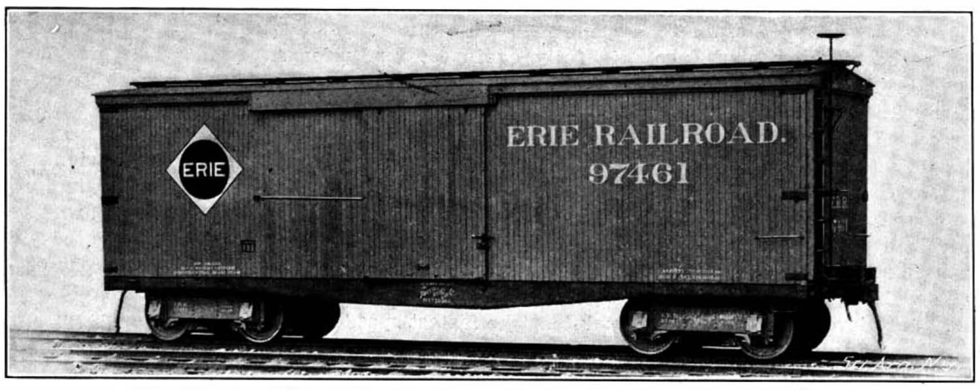
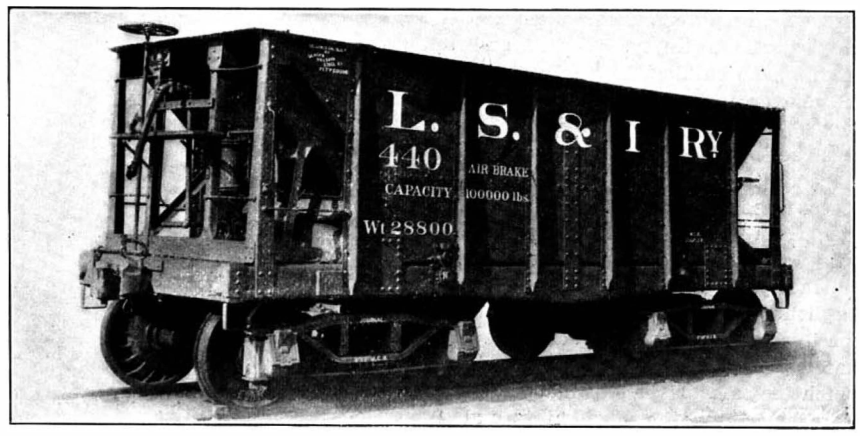


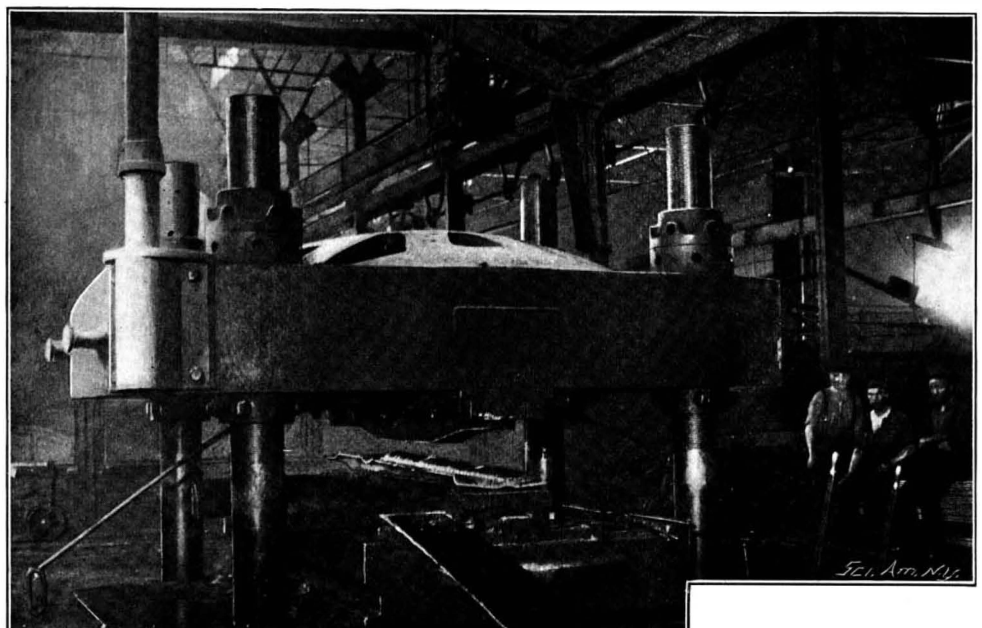
Train of Forty 50-Ton Ore Cars, Carrying 2,000 Tons of Ore from Lake Erie to Pittsburg.



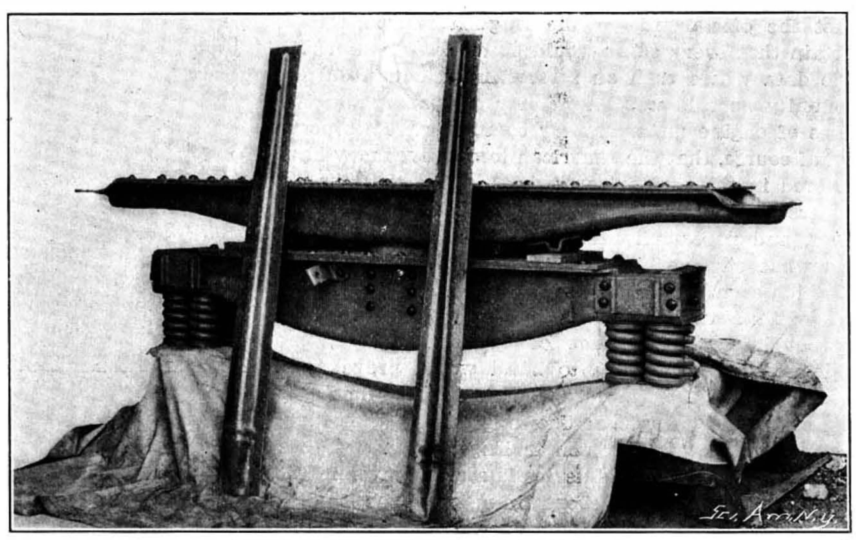

Box Car, 70,000 Pounds Capacity, with Pressed-Steel Underframing.



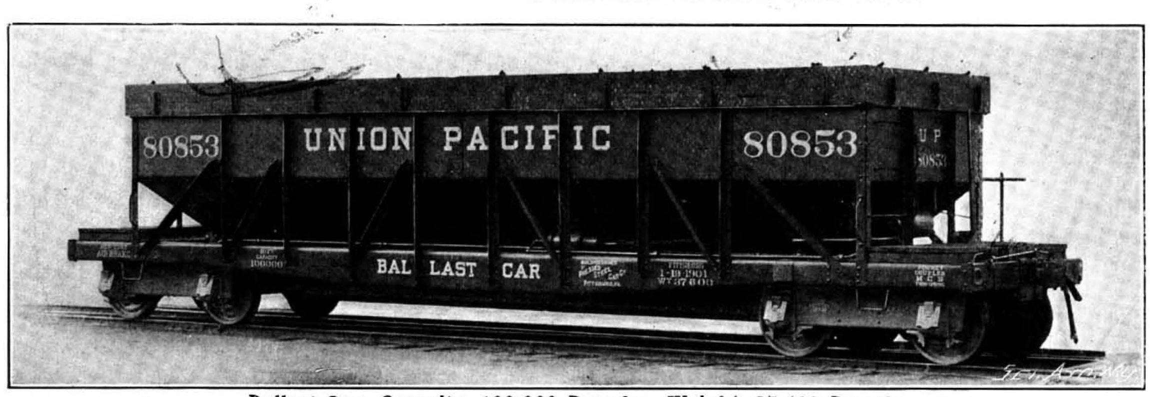

Ore Car—Capacity, 100,000 Pounds; Weight, 28,800 Pounds.



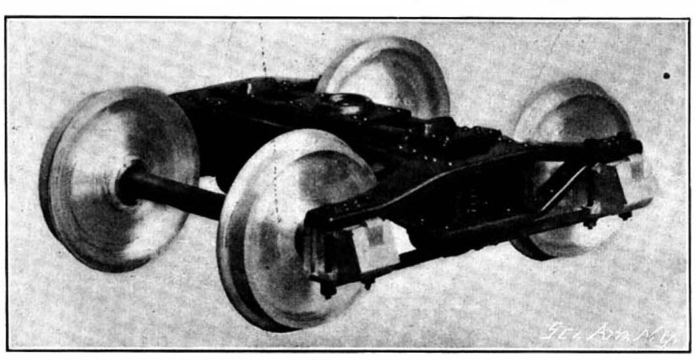
Hydraulic Press Forming Up Car Bolsters.



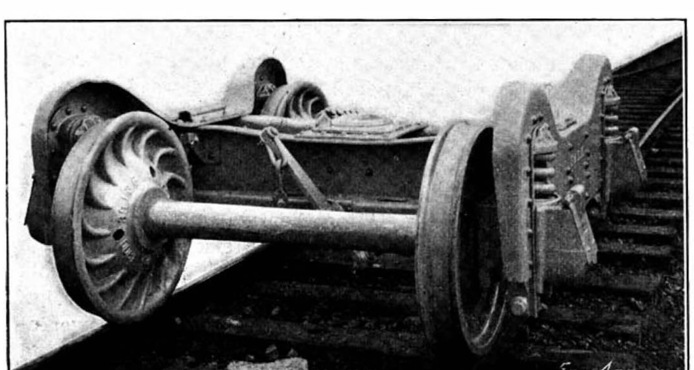
Pressed-Steel Bolsters and Side Stakes.



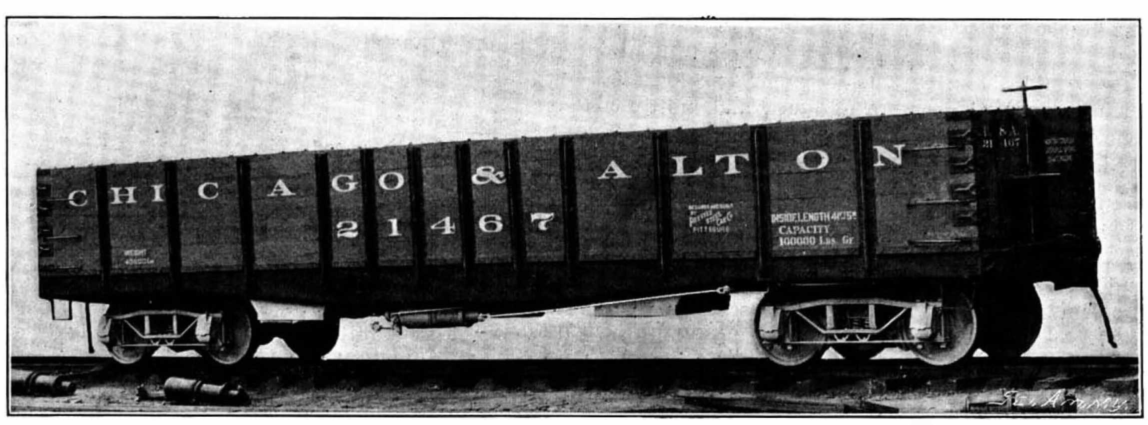

Ballast Car—Capacity, 100,000 Pounds; Weight, 37,600 Pounds.



Diamond Type Truck.



Fox Pedestal Truck.




Gondola Car with Pressed-Steel Underframing—100,000 Pounds Capacity.

THE PRESSED-STEEL CAR INDUSTRY.—[See page 391.]