RAIL CRISIS

The most important technical issue of concern to the entire modern American railway world, is undoubtedly rail crisis. I am familiar with it thoroughly, and I will tell about it in detail, in the way that these details will give the reader an idea of some of those characteristic features that railway business has to contend with in America.

With the invention of the Bessemer process, steel rails completely dislodged iron rails, and, over time, experience has shown that a steel rail best meets railway needs, such a steel rail contains 0,65 percent carbon, no more than 0,06 percent phosphorus and from 1,1 to 1,3 % manganese. Most of our railway authorities do not pay special attention to subtleties, regarding the rail section shapes – this is a question still remaining more or less controversial and unimportant, compared with quality of steel. Only steel, which is used to manufacture shipboard armor and artillery shells, must meet greater requirements, strength and malleability, than steel in a railway rail with modern rolling stock and the speed of passenger traffic. The main element of a steel fortress is carbon, whereas the presence of phosphorus in quantities exceeding the permissible ones, makes it brittle. In the Bessemer process for smelting iron from ore, natural carbon and many other undesirable ingredients are first blown out of the molten metal, then Spiegeleisen, an artificial composition containing a percentage of carbon, is added, depending on what steel is intended for, and after this it is poured out into the vessels of proper size and shape. At the same time, firstly, lighter impurities are deposited and accumulate in the upper part of the ingot, and secondly, as a result of uneven cooling coming from the form to the center, a bowl-shaped recess is formed, surrounded by cracks, gas and air bubbles and other imperfections. In order to get metal that is quite suitable for rails, it is necessary, firstly, to allow sufficient time for «Spiegeleisen» to penetrate into the mass of molten metal and to be evenly distributed within it, and secondly, when the ingots cools, to cut about a third of its upper part containing more or less imperfect metal and remelt this part again, since only the lower two thirds of the ingots meet the requirements. These are the main conditions required by our railways when they ordered the rails to the plants, and these latter had to guarantee their product. With organization of the steel trust in 1901, the situation immediately changed significantly. It was organized by Morgan, who had already been written about earlier, a man who has a huge, often overwhelming influence on the executive authorities of most American railways. The steel trust has swallowed up all the significant rail mills of America – only 2–3 small ones that are unable to meet 10 % of the country's annual rail needs are outside. At the same time, there occured a depletion of iron ores, free from more or less significant impurities of phosphorus, an element that is harmful and dangerous for rails, and, most importantly, not amenable to removal in production of steel through the Bessemer process. To make rails of the required strength from iron ores containing a large percentage of phosphorus exceeding the allowed maximum, i.e. 0,06 per cent, the Bessemer process of steel production is unsuitable, and the process of open furnaces (open hearth), used for manufacture of bridge steel, is necessary. There is only one such factory belonging to the steel trust, which was filled up with special work – and recently construction of a new, enormous plant, largest in the whole Union, in Gary, Indiana, on the very shore of Lake Michigan, has begun. Pressed by these factors, the steel trust five years ago, using its monopoly, began to refuse the railways to accept their orders for rails of the composition and quality of steel they required, and then refused any guarantee of the product. It changed the composition of metal without authorization, increasing the phosphorus maximum to one tenth of a percent, i.e. increasing it by 60 % against the level that the railways considered as permissible, and in order to balance this increase, reduced the amount of carbon to half percent and manganese to 0,8–1,1 %. But with this composition, the surface of rails exfoliates and wears quickly on curves.

The reduction in the quality of rails caused their frequent breakdown under the trains during movement, quickly resulted in growing number of derailments and dramatically raised the number of misfortunes with people. The statistics of the last five years proves that while the number of wrecks and misfortunes from almost all the other reasons specifically indicated in the official classification decreases, it grows strikingly from the breakdown of rails, and represents downright horrific figures. A train crash at full speed always causes a huge number of human casualties. Public opinion was agitated, anxious railway administrators took measures to open the eyes of the public on real perpetrators of this massacre. Last year, the American Railway Association of which 98 % of all the railways of the Union and Canada are members, appointed a special commission from especially experienced and well-known administrators to study the rail issue, and the report of this commission to the spring general assembly of the Association in Chicago was widely published throughout the country in order to acquaint people with its findings. This commission, having collected rails from all over the country, the breakdown of which caused the train derailment, through research by reputable experts, chemists and metallurgists, established beyond doubt their poor quality, completely inadequate to modern requirements for steel rails, and made the exact specifications they should respond in order to eliminate the risk of breakage. At the same time, the entire rail issue was given such urgent importance and publicity that the editor of Scientific American, our most authoritative and serious scientific publication, undertook a thorough study of the entire subject. Railroad Gazette, the best American newspaper devoted to the railway business, summarized its essence as follows:

«We attract the attention of the American people,

firstly, to criminal readiness of the steel trust to fabricate rails that kill people, secondly, to a position almost so criminal, occupied by a certain part of high railway officials, concerning unpleasant truths on the rails, which are presented to them by the chief administrators and engineers».

The New York State Government Commission for Railways certifies that during 1906, only within this state it recorded a breakdown of 2849 rails, and during the first three months of 1907, it recorded breakdown of 836 rails from those laid in 1906 and only 29 of those laid in 1901, i.e. fabricated prior to the change of conditions made by the steel trust since. The aforementioned Railroad Gazette lists entire columns of the same figures from the road reports of all other localities, evidences of managers with striking specific details. There is no any slightest doubt that quality of rails has rapidly and comprehensively deteriorated, and that responsibility for this most deadly factor in modern railway business rests entirely on the steel trust. All this agitation forced the officials of the trust to come up with public explanations. They do not deny the failure of rails fabricated from phosphorus-rich iron ores by the Bessemer process, but they claim that phosphorus-free ores are completely depleted in the Union, that railways have recently increased the weight of their rolling stock in a manner inconsistent with the weight of their rails, and, most importantly, the need for rails has increased so suddenly over the past two years that, although all the steel mills are working day and night, they are far behind with their orders and can no longer fulfill them on time. The only real remedy against evil is to remake the factories with the existing Bessemer process into plants with an open hearth – but this, firstly, would require huge capital investment, in fact, it will require to repeat the investment of initial costs, and the trust has no such funds, and secondly, would stop production for a long time at the updated steel plants and would completely stop the development of the whole rail business. It should be noted that in the third paragraph of its argument above, the steel trust is certainly right. Until 1906, construction of new railways in America for a long time was more or less uniform, and ranged between 5 and 8 thousand miles of new routes per year; in 1906 this figure immediately rose to 15 thousand miles, and in 1907, according to preliminary estimates, it will probably reach 25 thousand miles. Both figures are far superior to anything in the entire history of railroad construction in America. The conclusions of the editor of Scientific American are especially curious as they are unquestionably authoritative and at the same time impartial, the editor being like an arbiter between two contending parties. The editor came to the conclusion that, although the breakdowns should be attributed mainly to rails of the new fabrication, with an excess of phosphorus in the composition of metal, however, the haste of production undoubtedly plays a significant role in them. Instead of pouring in «Spiegeleisen» and giving it time to infiltrate and spread throughout the mass of molten metal, which was strictly required before, it is now poured into the forms of discs just before pouring it to vessels in order to save time – then, instead of cutting off about a third of the top of the ingots, cutting off only about one tenth or even less is made, so that three rails of 80 pounds per running yard are rolled out of the rest, while only two were rolled before. At the same time, he acknowledged that once the condition was set that the steel trust, with its real performance, must fulfill orders coming to it more or less timely, it is not able to change the current situation and give better rails, since its performance has reached possible maximum. The editor believes that the main cause of the crisis is depletion of iron ores free of phosphorus, and the need to refuse to Bessemer process in production of rails just at the time when an unprecedented and sudden rise in requirements for rails does not allow plants to be renewed.

It goes without saying that all these consequences and revelations helped the cause by the fact that they clarified its essence for public opinion, although they did not give a practical way out. The steel trust continues to manufacture brittle rails, train derailments become more frequent, and the number of those killed and wounded is growing. Unofficial data for the last two years, after June 30, 1905, gives an increase in the number of killed and wounded of more than 10 % every year, and this increase almost entirely falls on derailment of trains. Nevertheless, as the reader could, of course, see himself from the foregoing, it seems that the nature alone, which gave America too small amounts of iron ore without phosphorus, turns out to be guilty. The only consolation is that our jurors all raise the verdict in favour of the victims of railway accidents – now often awarding amounts of 30, 40, even 50 thousand dollars for a mutilation.

No matter how strongly the steel trust stands for possible keeping of the Bessemer process for making steel for rails, this process is undoubtedly condemned, and its final replacement is only a matter of time. The newest steel reinforcement experiments for rails are confined to steel, made through the open hearth process. The introduction of nickel raises the strength of the elastic resistance limit from 41330 pounds per square inch in Bessemer to steel to 49270 in nickel, but requires 3 % nickel, i.e. 60 pounds per ton, and the increase in product value is far from the increase in strength. Much better results are given by input of a ligature from manganese, chrome and vanadium. The railway rail is increasingly required to be able to withstand a sudden strong shock which is in our technical terminology, a dynamic property. Vanadium gives to steel not only strength, raising its elastic limit of resistance, with different compositions, up to 71110 pounds and even 224000 pounds per square inch (the last figure for Ac type), but also duetibility, so it reduces the size of the rail twice. At the same time, while 60 pounds of nickel per ton of steel are needed, the best results when vanadium is introduced are obtained at 12 pounds of ligature per the same ton, so that the high cost of vanadium compared to nickel loses its importance. However, vanadium ligature costs about $40 per ton of steel at current prices and conditions, which, of course, with the maximum cost of steel rails produced by the Bessemer process at $28 per ton, is a huge obstacle. Experiments with vanadium are going on with us everywhere with great energy, and it is quite possible that it is their future success that will resolve our rail crisis positively.

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