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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE SCIENTIFIC AMERICAN GOLD MEDAL FOR SAFETY DEVICES.

One of the most encouraging signs of the moral uplifting of the race is the unmistakable growth in these later days of the humanitarian sentiment. The dignity of the human body, the sanctity of human life, are swiftly emerging to their full and proper recognition. The reproach has lain too long at our doors that, as a people, we were so madly bent on the pursuit of wealth that we cared little who might fall by the way, if only the goal were swiftly and grandly won. To the question: "How much then is the life of a man worth more than that of a sheep?" we have made answer by rolling up a record of over half a million annual maimings and killings that may well put us to the blush.

Therefore it is gratifying to realize that the movement set on foot by the American Institute of Social Service for the promotion of an American Museum of Safety Devices is meeting with marked success.

In view of the fact that a very large percentage of these accidents is absolutely preventable, the editors of the Scientific American have decided to offer a gold medal, annually, for the best device for the protection of life and limb, produced during the year; said award to be given by the American Institute of Social Service, after the Board of Experts has passed upon the devices submitted.

THEORY AND PRACTICE.

In the current issue of the Supplement we publish two investigations of the conditions existing, or presumed to exist, on the curve on which the recent derailment of an electric train took place on the New York Central tracks near this city. The first of these is concerned with the pressures of the driving wheels against the outer rail; the second determines the shearing strength of the spikes, which, by yielding, permitted the rail to be displaced. The investigation of the lateral pressure exerted by the drivers, which was made by George F. Swain, Professor of Civil Engineering of the Massachusetts Institute of Technology, shows that, under the conditions assumed, the leading outer driver, at a speed of 70 miles an hour, would exert a pressure against the outer rail not exceeding 3,500 pounds. The investigation of the shearing strength of six spikes showed that they gave way under an average shearing load of 19,740.5 pounds. This would indicate that, under the conditions assumed, there was a factor of safety of between five and six against failure.

Now, while Prof. Swain's calculations are absolutely correct, and it is shown that theoretically it was impossible for the electric locomotives to have sheared the spikes; as a matter of fact, the conditions assumed for his calculation never exist, and in the very nature of things cannot exist, in actual railroad operation—a fact which is recognized when Mr. Swain states in his report, that it is "not necessary to call attention to the uncertain elements involved." The low pressures arrived at would obtain, only if the curve were laid out with absolute mathematical exactness; if the superelevation of the outer rail were, at every point in the rail, of the exact theoretical amount for the curvature and the speed; if the density and elasticity of the rail were perfectly uniform; if the outer edge of the base of the rail were bearing snugly against every spike; if the ballast beneath every tie were tamped so as to give an absolutely equal amount of reaction of the ballast against each tie; and lastly, and perhaps most important of all, if the electric locomotive were built with absolute fidelity to the design, and all the parts of it were functioning with the accuracy of a high-grade watch; then, and only then, would it be safe to accept Prof. Swain's figures as indicating the actual pressures developed.

As a matter of fact, however, not one of the above-named conditions exists in actual practice, and in many of them, the divergence is apt to be very great indeed; moreover, where the divergence is of such a character as to permit what might be called the statical stresses of these calculations to be changed into dynamical stresses, that is to say, wherever slackness of adjustment, or irregularity of the vertical or horizontal contour of the rail, permits pressure to develop into momentum, the resulting stresses will immediately mount up far beyond the figures herein found for the condition of an ideal locomotive riding over an ideal track.

As illustrating what we mean, it is assumed in the investigations that the lateral displacement of the outer rail is resisted partly by the strength of the spikes, and partly by the friction of the base of the rail on the tie plate. The lateral pressure of the leading driver on the rail is found to be 8,400 pounds. The frictional resistance of the rail base on the tie plate is assumed to be 25 per cent of the vertical load of the driver, or 4,735 pounds, leaving a resultant pressure on the spike of about 3,500 pounds. But let us suppose that, as the combined effect of furious driving and of some irregularity in the track, such as a flattening of the curve, or a local sag in the grade, the locomotive should commence to surge heavily against the outer rail, and that the blow of this 95-ton mass, concentrated at a single point (the flange of the leading driver) should be sufficient, for an instant, to cause a slight canting of the rail, so that contact between base and tie plate was had only at the outer edge of the former where it impinged on the spike. In that instant of time, if the inner edge of the base rail lifted but a hair's breadth from the tie plate, the 4,735 pounds of frictional resistance would practically disappear (the laws of frictional area notwithstanding), and the spike would have to take nearly the whole 8,400 pounds of pressure direct. But the 8,400 pounds would no longer be a statical pressure, if we may apply the term, and the resultant dynamic stress, produced by the violently-lurching mass of the locomotive, might easily carry the figures up to two or three times that amount; in which case the 19,740 pounds resistance to shearing in the spike might be exceeded.

Now that such a condition is possible is shown by the fact that on the morning of the accident one of these electric locomotives, running around the curve, at about the point where the accident occurred, struck the outer rail a violent blow, rebounded, struck the rail a second time, and then after a few more oscillations settled down without leaving the tracks. The impact was so terrific that it was thought by those in the cab that a derailment was inevitable; and, on reaching the end of the run, the incident (as was stated before the grand jury) was telegraphed back by the engineman to headquarters. After such a terrific bombardment by a single locomotive, it is little matter for surprise that under a double-header running at what was probably greater speed, the spikes, possibly already partly sheared through, should have given way altogether.

As a matter of fact, we cannot call to mind in the whole field of engineering a single structural element regarding which it is so impossible to determine the actual stresses to which it is subjected as the modern steel rail carrying the heaviest and fastest modern traffic. It is at once the most important single element in the whole roadbed, the hardest worked, and, in respect of any serious effort, at least on the part of the rail mills, to bring it up to the requirements of modern traffic, the most neglected. The day is coming, if it is not already here, when that miserable blacksmith's contrivance, the common railroad spike, must give place to some form of screwed fastening with larger bearing surface and very much greater holding power.

THE FOUR-DAY LINER.

The possibility of the construction of a 30-knot liner, capable of crossing the Atlantic in four days, has recently been made the subject of discussion by the naval architect who was responsible for the design of the battleship "Oregon." This gentleman states that the plans are practically finished for the construction of a torpedo-boat destroyer of 625 tons displacement, and 12,000 horse-power, which is expected to be able to maintain a sea speed of 30 knots an hour. This will be sufficient to carry such a vessel over the transatlantic course of 3,000 knots in about four days' time. The interest of this destroyer lies in the fact that it is to be furnished with producer-gas engines, and that it will represent the first attempt to apply this system of propulsion to a high-speed vessel. According to the designer, the machinery will weigh only 210 tons, or about thirty-five pounds per horse power.

It is a far cry, however, from a 625-ton destroyer to a 20,000- or 30,000-ton transatlantic liner; and although the sponsor of this gas-plant vessel declares that he can produce 30,000 horse-power for a total weight of 500 tons in engine and gas plant, and that with a supply of only 850 tons of crude petroleum fuel, it would be possible to build a boat that would maintain a speed of over 30 knots for 3,000 miles, it is certain that such a vessel would be altogether too small to have any commercial value in the transatlantic trade.

Let it not be supposed, however, that we have any wish to disparage the enthusiasm of those who believe in the future of the producer-gas engine steamship. On the contrary, producer-gas engines, in the limited degree in which they have been installed afloat, have shown the same fuel economy and other desirable qualities that they have demonstrated in service on land. A well-designed producer-gas engine will develop a horse-power on one-half of the fuel that is necessary in a good steam plant. But up to the present time, these installations have been of small capacity, and they have been subject to the serious limitation that they are successful only when a good grade of anthracite coal is used in the producer; and, of course, no large ocean steamship could be regarded as a profitable venture, unless she were prepared, in common with the steam-driven vessels, to take the ordinary coal of commerce into her bunkers. At present there is no gas-producer which is capable of handling successfully bituminous coal, the problem of the by-products from such fuel remaining yet to be solved. The proposed gas-driven destroyer, however, is to make use of crude petroleum, and we understand that the experimental work that has been done with this fuel has given most promising results. If it should prove to be possible by the use of petroleum to produce plants in the larger sizes, which will provide the necessary volumes of gas to supply engines of the size requisite to drive a transatlantic liner, a most important step will have been made in the direction of the large four-day boat.

There will yet remain, however, for solution the difficult problem of building successful gas engines of the necessarily large size required for the development of 30,000 to 40,000 horse-power. For it may as well be set down, once and for all, that the units must necessarily be of large size, and this for the reason that for the propulsion of large vessels at high speed, a certain minimum diameter of propeller and maximum speed of rotation is imposed. Let no one imagine that the problem can be solved by the use of multiple gas engines, driving a plurality of small propellers at high speeds of rotation. The same propeller restrictions which necessitated the 20,000-horse-power turbines of the "Carmania" being designed for such a low speed of revolution, and, therefore, of such great size, that they practically equaled in weight the reciprocating engines of the sister ship "Caronia," will apply in the case of the gas-driven ocean liner. For a 30,000 or 40,000-horse-power producer-gas plant, then, the cylinders will have to be of unprecedented size and weight, and this will bring the designer up against some very serious problems in cooling. Not only must the huge superficial area of the cylinders be cooled, but so also must the piston rods and pistons. Equality of expansion and the prevention of eccentricity of expansion would be an absolute necessity. However, in view of the ingenious design and marvelous accuracy of workmanship displayed in the development of the large-powered turbine, we have little doubt that ultimately the problem of the large-powered gas engine will be solved also, and that the four-day transatlantic liner will take its place as the rival, if not the successor, of the turbine-driven vessels. The advantages secured will be many and gratifying both to the shareholders and the traveling public. If petroleum fuel should be used, the present large bunker space would be available for passenger and freight accommodations, the fuel being carried in the double bottom of the ship. The dirt, dust, and odor incidental to the coal, smoke, and ashes of coal fuel would disappear, as would also the enormous smokestacks, which not only disfigure steamships, but in view of the enormous and little appreciated wind resistance, consume a not inconsiderable proportion of the horse-power.

THREE MONTHS OF DENATURED ALCOHOL.

Although barely three months have elapsed since the Tax-Free Alcohol Act went into effect, the time has been sufficient to demonstrate certain possibilities of the industries favored by the bill, and to indicate some phases of the law which are either inadequate or fail to meet the conditions called forth by the use of the tax-free spirit for specific purposes. It can fairly be said that, in general, the operation of the law promises to be satisfactory, and with a few amendments, it will doubtless successfully fulfill its purpose in all particulars. As was to be expected, the law became operative without the revolutionizing of American industrial and agricultural conditions prophesied by numerous too-ardent advocates of the measure. The Standard Oil Company, which controls our gasoline supply, is still apparently in as flourishing a condition as it was prior to the first of January, and the farmers, with few exceptions, are still utilizing their waste products for purposes other than the distillation of alcohol. Many manufacturing industries, it is true, have enjoyed the immediate beneficial