A LOCOMOTIVE DRIVING-WHEEL RECORDING DEVICE.

In view of the large number of railroad wrecks occurring during the past few months, supposed to be due to defective steel rails, much discussion has been given to the quality of steel used in the rails and the process by which they are produced.

Practically all the steel rails in use in this country are produced by the Bessemer process, the same general outline rail section being used, except from time to time as it has been increased in dimensions and weight to keep pace with the increased weight of the rolling stock.

While it must be admitted that too many rails have to be removed due to manufacturers' defects, at the same time it is hardly reasonable to suppose that all of the trouble due to broken rails is caused directly by these defects; and it is probable that most of the breakages of good-quality sound rails on straight track are caused by loads being placed upon the rails which neither the railroad engineer nor the rail manufacturers ever expected the rail to have to carry, as there are a number of instances of wrecks having occurred on straight stretches of perfectly good track, where the rail was subsequently found to have been broken, though made of good material, while the balance of the roadway was in the best of condition. All explanations heretofore advanced still left the cause shrouded in mystery.

A new thought has just been advanced for these failures on a straight track, and it was brought to light by experiments being conducted to locate the cause of uneven locomotive-tire wear. Mr. D. Patterson, master mechanic of the Colorado & Southern Railroad Company, devised a recording instrument by means of which he was able to transfer to a strip of paper the contour of the tires represented by an irregular line, which varies from a straight datum line an equal amount that the tire varies from a circle; the contour line approaching the datum line if there is a low or flat place in tire, and receding from it if there is a high place.

The recording instrument is called a tiregraph, and the records, tiregrams. By examining and comparing a large number of the latter, it was learned that in nearly every case the defects in the tire bore a fixed relation to the wrist-pin and counter-weights of the driving wheels.

This investigation was then extended to some other roads, and the conditions found to be the same.

The illustration shows the device held in position over the face periphery of the locomotive driving-wheel, having the disk pulley of the paper-winding spool in frictional contact with the outside edge of the wheel, the motion of which slowly draws the recording strip of paper over the platform, on which the record is made by pencils clamped to sliding bars. Another roller, secured to the lower end of a sliding bar, bears against the face of the driving-wheel and vibrates the lateral yoke holding one pencil back and forth, according to the inequalities of the wheel surface. The upper, inner edge of the initial sliding bar is provided with gear teeth, which mesh with the gear of a pivoted segmental wheel, so arranged that the small vibratory motion of the initial slide bar will magnify the movement of the second sliding bar three times greater, and also the pencil carried on this bar to correspond. Thus two records are made on one strip of paper, one of which shows a greater movement of the inequalities than the other, and in an opposite vertical direction. These tiregrams developed that the wear of tires was greatest in the neighborhood of the greatest weight in wheel. Thus, if the crank-pin and its parts were heavier than the counter-weight, the wear would be greater adjacent to the crank-pin, and *vice versa*. Whenever excessive wear was recorded the wheels were reweighed and balanced, and the disparity of weights corrected. In one case a high-speed passenger engine was found to be 230 pounds too light in the counter-balance, and several from 50 pounds to 150 pounds; this unbalanced weight being carried along at from 80 to 100 feet per second, was expected to run smoothly.

The engines tested were of various types—four-cylinder balanced compounds, tandem compounds, outside-connected compounds, simple piston valve and simple slide valve—and equipped with various systems of counter-balances.

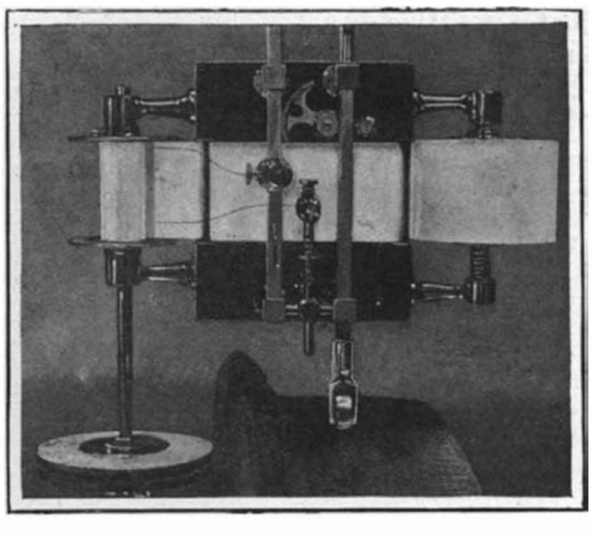
The balanced compounds were equipped with two counter-weights on each main driving wheel, and the wear on tire indicated the location of the weights had been altered, probably in an endeavor to correct the balance.

Most of the other engines were balanced under the master mechanics' methods, and had one counter-balance weight to each driving wheel, and the tiregram showed that if the crank-pin and its parts and the counter-weight were correct according to the formula used, the tires would not wear evenly, but would wear most adjacent to the crank-pin and the middle of the counter-weight, and the space between the weight and the crank-pin would appear as a high place on the tiregram, indicating unequal pressure of the wheel upon the rail.

If the counter-weight were moved toward the crank-pin to one side of its former center line, the high place would be reduced on that side, but would be increased upon the other.

One class of engines was found which produced practically parallel lines on the tiregrams, and they were balanced by the Davis method of using two counter-weights to each driving wheel, the weights placed 120 degrees apart, and forming with the crank-pin center an equilateral triangle.

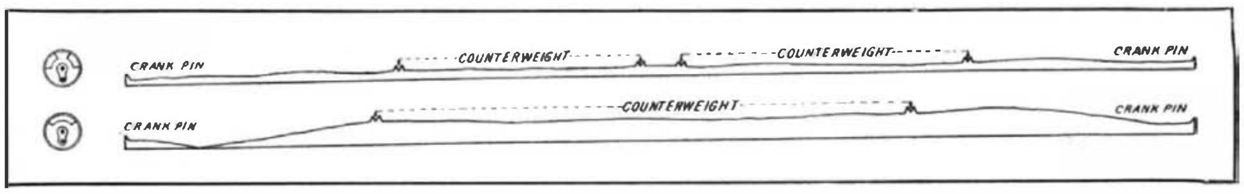
The upper of the two diagrams shows a more even movement than the lower one. The upper diagram represents the effect of balancing the counter-weights by the Davis method, which shows a fairly even line throughout. The lower diagram shows the common method of arranging the counter-weight opposite the crank, and it will be seen that the depression in the record line is very marked opposite the crank-pin. The position of the counter-weights is shown in the small circles at the end of each tiregram.



THE RECORDING TIREGRAPH.

The interesting conclusion that is drawn from this series of tests is that but one class of counter-balances examined showed practically even tire wear, and hence even pressure on the rail, and that all the others had unbalanced weights traveling through space at terrific speed, and at each revolution of the wheel striking powerful and destructive blows upon the rails, the effect of which would depend upon the kind of support the track had where each individual blow was delivered; and that it is probable that many if not all wrecks of high-speed trains on straight tracks where broken rails were subsequently found, were directly traceable to this condition of the counter-balances, and not to the material in the rails. It is also probable that where wrecks have occurred to trains hauled by electric locomotives without counter-balancing weights in their driving wheels, the initial damage to the rail was caused by a preceding train hauled by a steam locomotive, and that the final giving way of the rail only occurred when called upon to carry the following electric locomotive at high speed. It further indicates that the poor counter-balancing of the driving wheels may be responsible for the failure of a large number of driving-wheel centers, the spokes of which have broken out between the crank-pin hub and the rim, and which the manufacturers have attempted to strengthen by means of webs to connect the spokes to each other.

The above conclusions are only too amply verified by the experience of railroad operators, who have been compelled to replace long stretches of kinked and buckled rails and remove numbers of broken driving-wheel centers, both evidently due to the same cause.



RECORD TIREGRAMS, SHOWING THE EFFECT OF TWO FORMS OF COUNTER-WEIGHTS.

According to a British consular report, a Danish civil engineer has succeeded in producing beer in the form of tablets. These are dissolved in hot water, supplying, when cooled, beer of excellent quality and flavor.

A NEW EGYPTIAN IRRIGATION CANAL.

BY J. B. VAN BRUSSEL.

A very large irrigation scheme is now in process of development in Egypt. The area of land under preparation for irrigation and cultivation is about 125,000 acres; it is bounded on the west by the Nile, and to the eastward is the desert. It is almost midway between Assouan and Edfu; the soil is dry and parched, and is supposed to have received no water for the last 3,000 to 4,000 years. It is, moreover, saline, and for this reason it is necessary to wash the ground for from three to four weeks before any crops can be grown upon it. When first wetted, the ground swells and rises about six inches, afterward subsiding from one foot to two feet. The east bank of the Nile at Kôm-Ombo is too high to allow of the land being irrigated at flood time in the usual manner, and in order to obtain an adequate supply of water for the continual watering of this large tract of land, it was necessary to put down sets of powerful and specially-designed pumps. These pumps, which were supplied by Sulzer Brothers, lift the water through suction mains 6½ feet in diameter, and discharge it into riveted steel rising mains of the same capacity which in their turn deliver the water into a service reservoir. A large steel canal starts from this service reservoir, and delivers the water into distributing earth canals or culverts, from which it flows on to the land. The lift of the pumps is from 16 to 22 yards, and the top of the reservoir wall is 115 yards above sea level at Alexandria. The service reservoir was made of reinforced concrete.

The canal is composed of riveted steel, the plates being ¼ inch thick. It is nearly semi-circular in form, 6½ yards in diameter, with 20-inch straight sides at the top, being therefore nearly 12 feet deep. Its total length is near a mile. It is built up of seven plates round the circumference, the plates being connected together by ½-inch snaphead rivets, of which a total of 650,000 were used. The circumferential seams break joint. External T-iron stiffeners, 5 inches by 3 inches by ¾ inch, are riveted on at 2 feet 6 inches centers. There is also a top bracing of cross angles, and flat bars bolted on to 3-inch by 2½-inch by ⅜-inch curb angles. To allow for expansion and contraction, the canal was subdivided into seventeen sections, averaging nearly 105 yards each. These were connected together by masonry basins and packed expansion joints. At the end of each section of canal as it entered the masonry basin, a stiffening band 40 inches wide was riveted on, the external rivet heads being countersunk flush. This band is made to slide in and out of the basin on short sections of rail let into the masonry. The joint is kept tight by means of tarred or tallowed rope packing inclosed between two light semi-circular angles placed back to back with bolts passing through them. The weight of the water flowing through keeps the canal floating on the packing, and each section can therefore expand or contract according to temperature. In practice, we understand that it has been found that the movement is very small when the canal is running full. The recess containing the angles and the rope packing is slightly tapered, the smaller diameter being outside, so as to prevent the packing from being blown out by the pressure of the water. For riveting, use was at first made of a compressor plant and steam boiler, together with six long-stroke pneumatic riveting hammers and four calking hammers. Several Englishmen went out to teach the natives and to supervise their work. The native riveters were engaged chiefly from Cairo and Alexandria. Two to three months were spent to make them efficient with pneumatic tools, but the idea had finally to be given up, and the work was finished by hand. The rivets put in by the machines were, on the whole, better than those put in by hand, but the natives could not put in enough rivets per day to make the pneumatic plant pay as against hand work, and the conclusion was come to that the average native was not physically strong enough to work the machines to full advantage. About 15 per cent of the machine rivets had to be cut out. The calking hammers were, however, used right through the contract, and were found to be very useful. The men trained to use them were of the fellaheen class, from villages round Kôm-Ombo, and on the whole they were found to be much better and more reliable than the men from Cairo and Alexandria.

The method of leveling the canal was as follows: During the plating and riveting of the plates, timber cradles were used to keep the bottom level, and props to prevent the sides from dropping out of shape. The cradles were placed about 30 feet apart. The props were placed under the top curb, and shorter ones were fixed under angle cleats bolted to the first longitudinal seam from the top. As each section was completed,