RAILROAD GAZETTE

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Contributions.

A Clever Device in Filling a Trestle.

NEW YORK, Dec. 11, 1896.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your issue of Dec. 11 you show a photograph, "Filling a Trestle," and state that under the specifications all boulders were excluded, but that it is obvious from the photograph that boulders could not always be kept out.

The statement does not do justice to the ingenuity of the contractor and the success of his method. The specifications stated that all boulders were to be excluded, this provision having been introduced as the only material that could be economically obtained for filling the trestle was found at a bank in which occurred a large number of boulders. The contractor requested that this part of the specifications be so modified as to permit him to use the boulders, he assuming all liability in regard to damage to the trestle. The device that he used was eminently successful, the material as it came from the shovel being screened, but boulders of considerable size being allowed to go into the bank. These boulders, however, in all cases were deflected by means of the screen and carried out to the edge of the embankment, where they were used as a protection. The part of the bank on which the load rested was composed almost entirely of fine sand. WM. BARCLAY PARSONS.

Green Lights—and Some Other Things.

TAUNTON, MASS., Dec. 15, 1896.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Such strong arguments as those presented in your columns against the use of white lights in semaphore signals could not fail to take effect sooner or later (though most superintendents and signal engineers have expected it would be later rather than sooner) and your readers will perhaps be surprised to hear that signs of action appear first in the conservative East. The leaven is working, but not as yet in the most satisfactory manner. As an overdose of yeast in the hands of an inexperinced cook makes the bread burst its bounds so the leaven of logic has here led to a result that will make it necessary sooner or later to try over again.

A prominent railroad in this state has put up a signal with a green light for all-right and a red one for danger, but has followed the English idea of making the distant signal precisely like the home; and has disregarded the plain lessons of experience, both in England and in this country, by omitting to interlock the distant with the home. What do you think of that? And the rule requires trains to *stop* at the distant signal when it shows red. Just as the Englishmen are beginning to see the absurdity of this antiquated rule, we Yankees are taking it up!

Verily the locomotive engineer can continue to assert that he is the chief man on any railroad, and that therefore he is truly the hero of the rail. In the old times he was required to run without any signal at all and to be responsible for safety and for reaching the end of his trip on time, in spite of careless flagmen, of freight conductors with poor watches and of section masters who notified him of washouts or not, just as they happened to see fit. Those conditions are now mostly done away with, and many improvements have been introduced; but here we have a modern combination which demands impossible things of the engineers in a way as perplexing as any of the old-time crudities (although I say "modern" I cannot say "novel" for equally defective conditions exist in other places). The engineer must be able to stop at a distant signal without receiving advance information of how he may expect to find it, and yet he must *make time*; and making time is no easy thing nowadays. Although powerful engines are provided, the weight of the cars and the required speed are increased, and the engineer's task is more difficult than ever. Can there be any doubt how he will meet it? When in doubt, on account of a poor view of a distant signal, he will take chances. And, as of old, if he is alert and cautious he will probably stave off the day of disaster so long that the officers of the road will go to sleep in the confidence that they have "the best runners in the country." Which way is the art of signaling progressing, backward or forward?

L. M. A.

[The art, or science, of signaling is progressing, and progressing in the right direction. This, we have no doubt, is the right answer to the question of our correspondent, though he seems to expect us to say that the contrary is true. The thing described in his letter must be an experiment; and if it is intelligently followed up, it will probably lead to something better. The signal engineer who made it evidently aims to cure an admitted defect in the ordinary plan of signaling, and that is a laudable motive. Massachusetts was the scene of a derailment, recently described in these columns, which was due to a broken red glass; it may be that that is what started this movement for a change. As for practice under this signal, as it is described, the most that can be said is that, if the superintendent desires to continue it in peace, he should thank his stars that he is in New England instead of Old. A distant signal not interlocked would be held by the British Board of Trade sufficient reason for declaring a railroad not entitled to the government certificate authorizing it to run trains. A rule making the distant a stop signal is sure to make trouble with fast trains either in England or America; but unfortunately it seems to be easy in both countries to keep rules on the book for years while constantly winking at their violation. In the case of this particular rule the winking process has been going on so long that it has on some roads become a profound slumber. At least, so it appears.—EDITOR RAILROAD GAZETTE.]

Cast Steel in Locomotive Building.*

Paper by Mr. Sague, Mechanical Engineer of the Schenectady Locomotive Works.

One of the most interesting of the recent developments in locomotive construction has been the increasing use of cast steel, and before taking up in detail the advantages gained, it may be of value to mention the general reasons which have led to its wide substitution for cast and wrought iron. These reasons are, first, a desire to use as large a boiler as possible and the consequent lightening of the other parts as much as strength and durability will permit; second, the growing need for a stronger material than cast iron to withstand the increased strain of the large cylinders and high steam pressures used in modern locomotives; third, a desire to lighten reciprocating parts and thus reduce the effect of reciprocating counter-balances on the track; and, fourth, the substitution of cast steel for difficult and expensive forgings, which has been rendered possible and economical by the decrease in cost of steel castings and the improvement in quality. In this connection the following is quoted from a letter received from the American Steel Casting Company:

"The main point of advantage in the use of steel castings as a substitute for cast iron is the great saving in weight; and as a substitute for forgings is a saving in machine work, due to being able to cast close to finishing sizes."

The necessity of obtaining the maximum of power with the minimum of weight is the feature of locomotive designing which, perhaps, involves the greatest difficulty and requires the most careful consideration of any condition by which the locomotive designer is limited, and in this locomotive designing differs radically from that of stationary engines. . . . For most passenger service, at least, the ability of the locomotive to do work is limited by its boiler capacity, and it is believed that the great demand upon the boilers of modern locomotives has been caused more by the increase in train speeds than by the increase of weights. With the maximum loads permitted on the rail it is often very difficult to use boilers large enough to do the work required, and it is necessary for the locomotive designer to lighten parts wherever possible in order to make up for the weight which must be put into the boiler. It is this necessity more than any other which has led to the increasing use of cast steel in locomotive construction.

The demand for a stronger material than cast iron, to withstand the strains of large cylinders and high steam pressures, has also been notable. The increase of strain due to high steam pressure is clearly shown from the fact that a 19 × 24-in. cylinder with 180 lbs. of steam has more power than a 21 × 24 in. with 145 lbs., the higher steam pressure corresponding in this case to an increase in power of 24 per cent. Increasing the size of parts to correspond with such increases of power is difficult in many cases, and with cast iron, unfortunately, increase of section does not mean an equal increase of strength.

The necessity of reducing the weight of reciprocating parts as much as possible does not need to be dwelt upon, and cast steel enters largely into the construction of the light reciprocating parts used in recent locomotives.

The superiority of cast steel over wrought or cast iron in strength and ductility is seen from the following tests taken from the records of the testing department of the Schenectady Locomotives Works. Average results from 140 tests taken from cast-steel wheel centers applied to passenger and freight locomotives; tensile strength, 71,400 lbs per square inch; elongation, 19.2 per cent. in 8 in. and 24.1 per cent. in 4 in. In each case the test pieces were cast on the wheel, one test piece representing each center. The record of tests also shows the location of the wheel centers for each engine. For comparison it may be said that first-class cast iron has an average tensile strength of from 20,000 to 30,000 lbs. per square inch with practically no elongation, and wrought iron a tensile strength of 48,000 to 50,000 lbs. with an elongation of 20 per cent. and upward in 8 in. The figures thus show that cast steel suitable for locomotive use has nearly three times the tensile strength of cast iron and 50 per cent. more than wrought iron. It also has the great advantage of high ductility, being nearly equal in this respect to wrought iron.

In order to realize the full benefit of the great strength of cast steel, however, much care must be exercised in the designing and manufacture of the castings. Cast steel has 50 per cent. more shrinkage than cast iron, and is much more liable to unequal shrinkage strains, which, unless carefully provided for, will more than offset the high tensile strength. It is the practice of the works with which the writer is connected to ask the criticisms of the steel-makers upon the design of difficult castings, such as wheel centers, and modify the distribution of metal accordingly. In general it may be said that the rules for correct proportioning of iron castings, regarding uniformity of section, large fillets, etc., apply with greater force to cast steel.

The use of cast steel as a substitute for cast iron generally increases the first cost of locomotives, the cost of the process and greater percentage of loss making the price per pound about three times that of cast iron, against which the saving of weight in most castings is only a small offset. The cost of machining is also considerably greater than for cast iron, as more finish is required to allow for unequal shrinkage, and the hardness and toughness of the metal requires the machines to be run at low speeds with light feeds, thus increasing the cost of labor and lessening the output of the shop. In some cases, however, steel castings may be substituted for difficult forgings with a saving in first cost, but thus far this has only proved true for locomotive use in a few cases and with small forgings.

Steel castings are used in this country more or less extensively for the following locomotive details: driving-wheel centers, driving boxes, cross-heads, frames, pistons, expansion pads and knees, dome rings, rockers and foot plates.

The substitution of cast steel for cast iron for driving-wheel centers in American locomotives has been very recent. The first steel centers applied by the Schenectady Locomotive Works were put in service May 1, 1895. Since then 500 wheel centers have been used in passenger and freight service, including locomotives now under construction. Thus far the principal use for steel driving-wheel centers has been for large passenger engines, but quite a number have been applied also to freight engines. For passenger locomotives the main advantages of steel are its decreased weight and greater strength. A photograph which I have with me shows cast iron and steel centers 62 in. diameter, designed for the same service, the saving in weight with the steel being about 610 lbs. per center, or a total saving for a four-coupled engine of 2,440 lbs. I also have blueprints with me of different designs of steel driving-wheel centers applied to passenger and freight engines. The strength and shock resisting power with the steel centers, even with a lighter weight, is undoubtedly very much greater than that of cast iron; in fact, with sound castings, free from shrinkage strains, it is difficult to see how a steel center can be broken except in a wreck. Great care, however, must be taken to avoid shrinkage strains. The rims are split in four places, which are carefully slotted and fitted tightly with planed cast-iron plugs driven in so that the shrinkage of the tire will make the rim practically solid. Great care must also be taken in pouring the metal and while castings are cooling. The steel makers say, for instance, that the baked moulds are so hard and unyielding that if the sand is not broken away almost immediately after pouring, shrinkage flaws are almost certain to develop. An incidental advantage of steel centers, which is appreciated by the engineers, is the chance given for oiling and inspection through the large spaces between the spokes and around the hubs.

A difficulty involved in the use of cast-steel centers is the necessity of providing for hub wear, as it is well known that cast steel does not wear satisfactorily against cast iron. This has been provided for by the use of cast iron or bronze hub liners, or a facing of babbitt or bronze on the driving-boxes. Babbitt and cast steel are said to wear well together. Thirty locomotives recently built at Schenectady for the New York, New Haven & Hartford Road, with steel wheel centers and driving boxes, had the driving boxes faced with babbitt, the hubs of the wheel centers being simply faced off as smooth as possible, and these are reported to be wearing very satisfactorily. Driving boxes faced with bronze are also said to wear well against cast steel.

Cast-steel driving centers for freight engines allow of a considerable decrease of weight, but the advantage of increased strength is probably of even greater importance, especially for the main wheels, as all six and eight-coupled engines must have the main rod connected to the outside of the crank-pin, thus exerting great leverage on the wheel center around the crank-pin hub. When made of cast iron these parts must be very heavy, and even when all possible has been done in design and material, cast-iron main wheel centers are liable to give some trouble from cracking on heavy engines. It is believed that this might be entirely overcome with well-constructed steel centers, and the lightening of the hub and rim which could be obtained would allow of increased counter-balance being put in the main wheel, as in small-driver engines, with cast-iron centers, the balance on main wheel must often be deficient.

For driving boxes, cast steel has thus far had but limited use in spite of its great strength and the trouble experienced with broken cast-iron boxes. Probably one of the main objections to a more extended use of steel boxes has been the fear of bad results from wear between the box and wheel hub, and at the wearing surfaces of the shoes and wedges. Babbitt or bronze facing, however, seems to settle the question of hub wear satisfactorily. The large steel driving boxes fitted up for the New Haven engines, before referred to, had no special provision made for wear against the shoes and wedges, and we are assured that the results in service have been most satisfactory. Assuming that the wear can be made satisfactory, it is believed that steel boxes are destined to be quite generally used. Compared with cast iron they give great strength and freedom from breakage, can be made to save considerable in weight, and the flanges can be reduced in thickness, if desired, and thus allow the shoes and wedges to be widened to give more wearing surface. Steel boxes, also, being much stiffer than cast iron, would have less tendency to spring when the brass is pressed in. As compared with solid bronze, steel boxes expand less with heat and can therefore probably be run with a closer adjustment of wedges. The following letter received from Mr. John Henney, Jr., Superintendent of Motive Power of the New York, New Haven & Hartford Railroad, gives very valuable information on the subject of the wear of steel boxes:

* An abstract of papers and discussion at the November meeting of the New England Railroad Club.