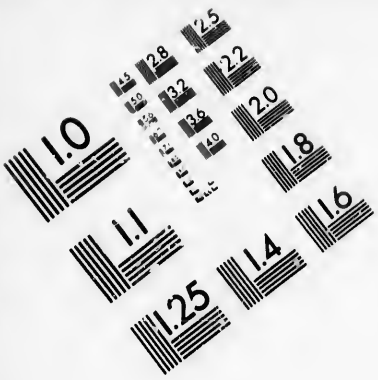

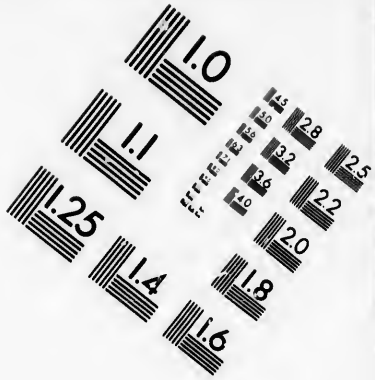

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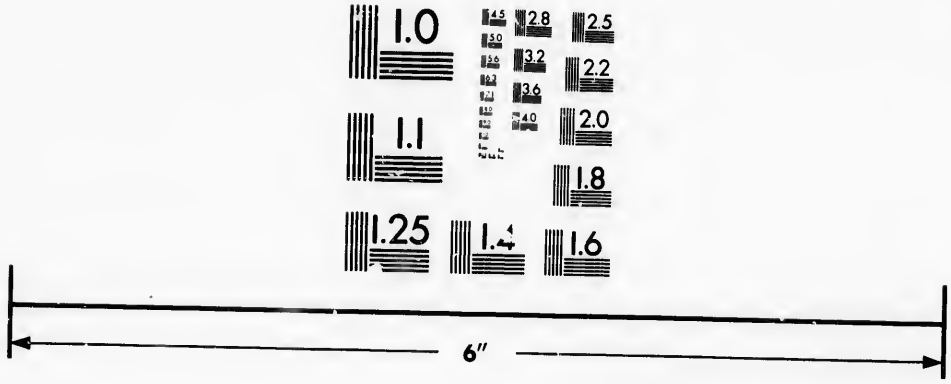

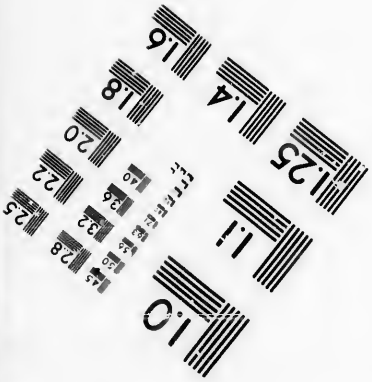

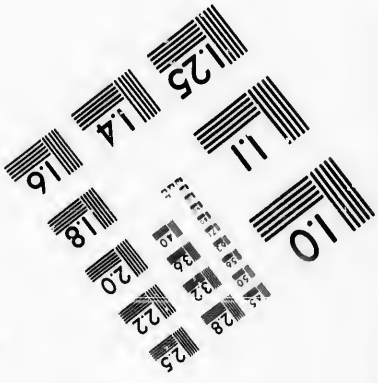

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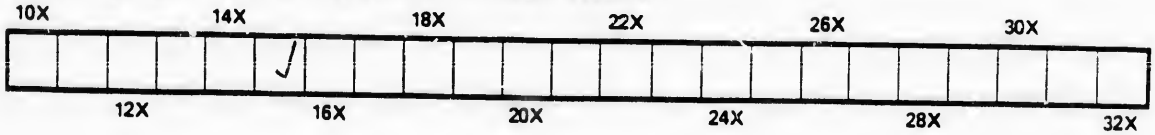

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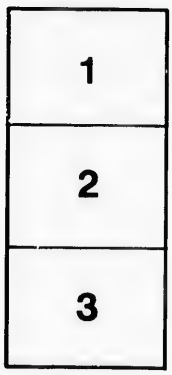

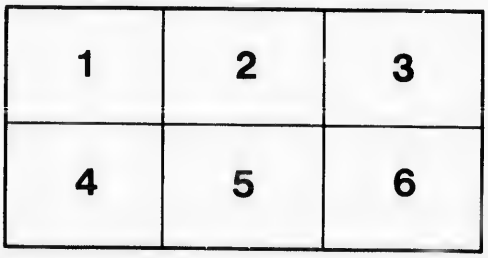

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Cast Iron Chilled Car Wheels

Compliments of

The Association of Manufacturers
of Chilled Car Wheels.

Cast Iron Chilled Car Wheels

Mode of manufacture and relations
they bear to economy in
railway practice

The Association of Manufacturers
of Chilled Car Wheels

1895

The following article has been carefully prepared by the Secretary of the Association of Manufacturers of Chilled Car Wheels, at the request of the Association at its last Annual Meeting, and having the endorsement of the Executive Committee, it is hereby presented to you for your consideration.

WM. W. LOBDELL,
Secretary.

To the Railroad Officials of the United States and Canada.

Cast Iron Chilled Car Wheels are distinctively an American product, although manufactured to a limited extent in Austria and Sweden. Their use on steam roads is confined chiefly to North America, and to those sections of Central and South America where the American system of railroads has been adopted. Their use on street roads has become quite universal, and they can be found running under horse and motor cars the world over.

The output, from possibly ten or twelve wheels per day in 1830, confined to, at most, two or three establishments, has grown to one of millions; the product of more than one hundred establishments,

controlling millions of capital and employing thousands of skilled workmen.

Probably no one article has contributed so much to economy in the Railway practice of America as that of cast iron chilled car wheels. Commencing with the introduction of the early tramway, through the various stages of development into the modern railway of to-day, their use has been continuous and uninterrupted, and we feel warranted in claiming that there is no other article so universally used on railways and upon which so much depends, that can be produced as cheaply and quickly, and which, when worn out, represents as large a per cent. of its first cost.

That chilled wheels should hold their position, their usefulness unimpaired for so long a time is evidence that they possess some special merit, and should be entitled to such consideration from those who use them as to warrant hearty co-operation in any plan that will increase their efficiency and safety.

Comparatively few persons—although actively engaged in railroad management — have acquainted themselves with their mode of manufacture and consequent characteristics, and therefore, are often led into unwise conclusions as regards the limits of their efficiency. To such it may be interesting to note that "when certain kinds of gray cast iron are melted and poured against a metallic mould, that portion of the iron next to the mould becomes hard, white, crystalline and brittle, while the interior portion remains gray and more or less tough and fibrous. This conversion of the iron that comes in contact with the metallic mould, into the hard white variety, is called 'chilling,' and it is upon this principle that the manufacture of chilled car wheels depends. This property of chilling, which certain irons possess, must have been known to iron founders at an early day, for we have evidence of the fact that parts of plows, faces of forge hammers, punches for punching holes in wagon tires, rolls for rolling

metal, and various other implements were chilled, long before the manufacture of car wheels."

As the early mode of smelting iron ores was with charcoal, it follows undoubtedly that chilled castings and chilled car wheels were originally made exclusively from charcoal irons; and although later developments have demonstrated that, under certain conditions, coke or anthracite irons possess this property of chilling to a certain extent, they have not come into sufficient prominence for us to consider them as important factors in this branch of manufacture; so that to produce the best results we may consider the use of charcoal iron as indispensable. All irons do not possess the property of chilling, and many that do possess it are not well adapted for use because of characteristics which would render the wheels made from them unreliable.

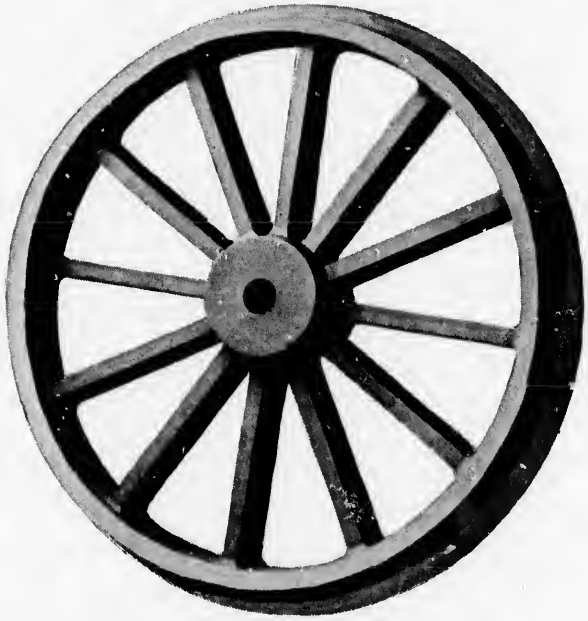
Noting, then, this peculiar property of chilling, it is obvious that the plates and hub of the wheel must be cast in a sand mould, the result

being that they are soft enough to be bored or machined, while the tread is so hard that the finest tempered file will not affect it. What, then, is this peculiar property of chilling? The supposition is that the chemical difference between the chilled portion of a wheel and the plates or hub is simply in the proportion of combined and free or graphitic carbon, that of the chilled part being high in combined carbon, the free or graphitic having been changed to combined by the rapid cooling of the tread by reason of being cast against a metallic mould, technically called a chill.

This rapid cooling of the tread of the wheel —the metallic mould in which it is cast being a good conductor of heat, whilst the sand mould against which the hub and plates are cast is a poor conductor — causes an undue strain upon the wheel, which must be relieved in some manner or the wheel would be unfit for service.

The earliest form of wheel was of the ordin-

ary flat spoke pattern, with the hub separated longitudinally in three places, thus relieving this strain, and preventing the arms or spokes breaking in cooling. The separation of the hub necessitated

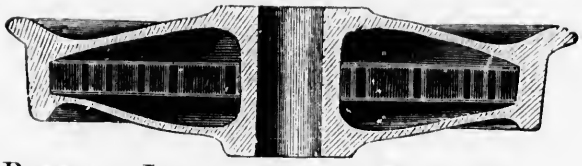


its being banded with a wrought iron band before the wheel was keyed on the axle.

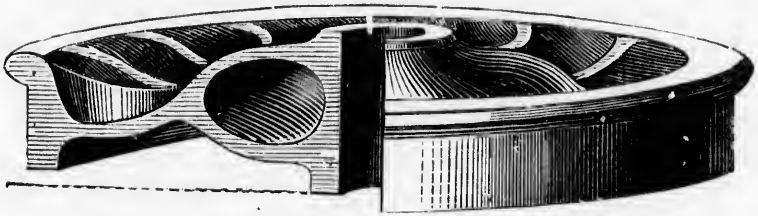
With the adoption of the form of pattern such as is used to-day, whether the Bush & Lob-

dell, Eddy, or Atwood–Washburn, Double Plate, the Hollow or Solid Spoke or the Single Plate, came the necessity for some mode of slow cooling or annealing. Probably the first method practiced was to take the wheels from the moulds in which they were cast as soon as the iron was set, and cover them up in hot sand or ashes and allow them to remain several days until nearly cold. Another was to lay them on the floor and build a fire around the tread so as to bring the temperature of the tread up to that of the hub and plates, and then allow them to cool slowly. To a certain extent both of these methods accomplished the desired results, and were probably sufficient for the requirements of the times in which they were practiced.

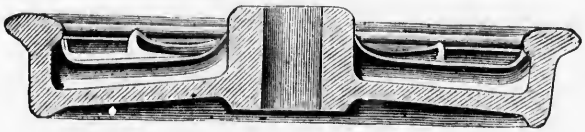
The latest and probably the best plan is to place the wheels, as soon as they can be removed from the moulds, in tight pits lined with fire-brick or some other substance that will stand the heat, ten or more in each pit. The equilibrium of heat



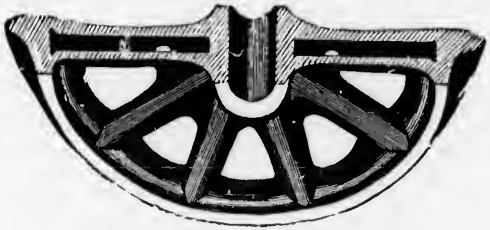
Bush and Lobdell Double Plate Wheel.



Atwood-Washburn Double Plate Wheel.



Single Plate Wheel.



HOLLOW SPOKE WHEEL.

SOLID SPOKE WHEEL.

between the tread and plates and hub, which has been destroyed by the rapid cooling of the tread by reason of the chilling process, is then restored, either by the development of latent heat, which occurs when so many hot wheels are confined in tight pits, to an extent sufficient to equalize the temperature of the different parts of the wheel; or by passing a current of cold air through the hubs of the wheels, which rapidly reduces the temperature of the centre of the wheel until it approximates that of the tread; or by having the pits heated before the wheels are placed therein, and then by the application of additional heat rapidly raising the temperature of the tread until it approximates that of the plates and hub. The wheels are allowed to remain in the pits several days and are not removed until all tendency to fracture from strain has been removed.

From this hasty resumé of the mode of manufacture, it is obvious that to insure a thoroughly safe and reliable wheel, great care must be taken in the

selection and manipulation of the material used, as well as in the treatment of the wheel after it is cast; indeed, so well is this known, that the manufacture of chilled car-wheels is considered as entirely separate from ordinary foundry practice, and is carried on in establishments especially adapted to the work.

The efficiency of cast-iron chilled wheels depends upon their strength and wearing qualities. If the specifications and physical tests formulated by expert mechanical engineers and adopted by the most prominent railroads of the country—and which are now much more severe and exacting than those first formulated—can be taken as the maximum required to meet the conditions of the increase in speed and weight of equipment of the present time, then the limit of strength of cast-iron wheels has not been reached, as they are successfully met by all reputable manufacturers; and as long as charcoal irons can be produced approximating 35,000 to 40,000 pounds tensile strength per square inch, it is not likely that the limit of strength will be exhausted until the

speed and weight of equipment is increased beyond anything now contemplated.

Assuming, then, that cast-iron chilled wheels meet all the requirements of the physical test and specifications as to strength and depth and character of chill, we have yet to consider their wearing qualities.

We have seen that the chilling process has transformed the iron in the tread of the wheel from a soft, dark-colored metal with a semi-fibrous fracture, into a metal white in color, hard in character, and with a crystalline fracture. If a proper mixture is used, this chilled iron is harder than any steel that can be safely used in a tire, and consequently, under favorable conditions of service, should give excellent mileage results,—instances being numerous where a mileage of 200,000, in some cases 300,000 miles has been obtained from 30- and 33-inch chilled wheels. These results cannot, however, be produced with the use of inferior irons, and they are not one of the conditions resulting from this era of extreme low prices.

The separation of the iron in the tread of a wheel into crystals by this peculiar process called chilling, should indicate that although it provided a wearing surface of extreme hardness, yet under certain conditions of service its peculiar crystalline structure would render it liable to defects not applicable to a metal of the structure of wrought-iron or steel.

Such defects as are incident to improper manufacture, and for which the manufacturers are undoubtedly liable, we will not here refer to. We wish, however, to call attention to such defects as are incident to the service, and to impress upon railroad officials the importance of guarding against them as much as possible.

Probably more serious defects occur in cast-iron wheels from the excessive use of the brake than from all the other causes combined. Excessive heat will destroy the life of the "chill." If by any process it is continued to a "red heat" point, it eventually transforms the crystalline structure back into the

semi-fibrous. The application of the brakes, when severe enough to slide the wheel any considerable length of time, results in the heating of the tread at that particular point to such a temperature that a separation of the crystals composing the chill occurs, as can be noticed by fine fire cracks on the surface; further service results in a disintegration and shattering out of these crystals. As a result, shelled-out spots occur; such spots being readily distinguished by their ragged, cuppy appearance, and the absence of a high point in the center (like the defect termed a blotch, for which the manufacturer is generally held liable). If the tread of the wheel is broken through these shelled-out spots, the chill will be found to be discolored by the heat to a deep violet color, which discoloration can be produced in no other way.

That this peculiarity was not thoroughly understood by many railway officials is evident, as, until lately, in many instances they claimed that this was a defect for which manufacturers were liable.

The sliding of chilled wheels results not only in

the disintegration and shattering out of the chill, but, by expanding the tread, in cracked plates and brackets, and other defects which necessitate the removal of the wheel. If the application of the brake could be more carefully regulated, the life and safety of the wheel would be increased one hundred per cent., and many thousand dollars saved to those who use them.

Whilst the efficiency of chilled wheels may in a measure depend upon the shape and form of the pattern from which they are made, it is not the purpose of this article to enumerate and describe the different patterns of wheels used, although it might be interesting to know that between the years 1849 and 1860 there were no less than eighty-eight patents granted (how many refused is not known) for alleged improvements in the form of patterns of cast-iron wheels. The original double plate wheel, as invented by the late George G. Lobdell in 1838, and the modification of it later into the Atwood-Washburn pattern, and the hollow and solid spoke wheel, practically remain

the patterns in use to-day; and it is worthy of note that manufacturers of steel tired wheels in their patterns have followed very closely the same shape or design.

From the fact that cast-iron chilled wheels are universally used on the railroads of the United States, Canada, Mexico, Cuba and South America under engines and tenders, passenger and freight cars, running on fast express trains as well as heavy freight trains, and on roads of heavy grades and sharp curves, under all conditions of service and exposed to the greatest extremes of temperature, is it not positive proof that they possess as many elements of safety as any other kind of wheel? Any exception to this would only be in individual cases and not in general results.

The object and aim of the manufacturers of cast-iron chilled wheels have been to meet every requirement of service imposed upon them. Prior to and for some years after the war, the usual guarantee for a thirty-three inch chilled car wheel under engines,

tenders, passenger and freight cars whose weight, capacity, speed and mileage was less than half what it is now, was one year time service. To-day, with an increase of weight in the wheels of probably ten per cent., manufacturers have to meet a condition of service requiring for the same diameter of wheel a mileage of not less than 60,000 miles under passenger and tenders, and four years time service under freight cars, with the addition, in many instances, of a physical test, and at a reduction of price—when the price of labor and material is considered—that is unprecedented.

How well they have succeeded, the following from the report of the wheel committee of the Master Car Builders' Association, dated May 26th, 1892, will show:

"In conclusion your committee expresses briefly the opinion that the experiments made and being made in the distribution of metal by those connected with roads which have facilities for making experiments, places the members of our body under obliga-

tions to them, and wheel makers are entitled to more credit than they now receive for the production of a cast-iron wheel weighing less than 600 pounds guaranteed to carry our largely increased loads, running forty to fifty miles per hour for 60,000 miles, at a cost far below the price we pay for other parts of our car and locomotive castings. When we consider the remarkable progress in the manufacture of cast-iron wheels, and how well the makers of such wheels have kept to the front in the 'wheel procession,' we must admit that they are entitled to a large amount of credit.

GEO. W. WEST,
W. H. THOMAS,
JOHN PLAYER,
Committee."

"*May 26, 1892.*

The success which manufacturers have had in meeting these conditions, while it may have had the effect of convincing railroad managers that there was yet much merit in the chilled wheel, brought with it

some conditions regarding replacement of wheels for alleged defects which seemed to bear with undue severity upon them, and it was with the hope of being able to come to a better understanding regarding them and to induce a uniform system of guarantee and physical test, that an association was formed in order that they might be placed as a body in communication with the two representative associations of operative railroad men, viz.: The Associations of Railway Master Mechanics and Master Car Builders.

To this end, on the 27th of January, 1887, the representatives of thirty-five of the leading establishments of the country assembled in New York for the purpose of forming an association. The object as distinctly stated in the call was not in any manner to control or regulate prices, but to provide the means for the interchange of opinion and discussion on matters pertaining to the manufacture of cast-iron chilled wheels, and particularly to induce some concerted action on the part of railroad officials relative to wheel guarantee and physical tests. A full organiza-

tion was effected at a meeting held at Minneapolis, Minn., June 16th, 1887, at which the Hon. W. H. Barnum was elected President, J. H. Bass, Vice-President, W. W. Lobdell, Secretary, N. P. Bowler, Treasurer; with an Executive Committee consisting of W. W. Snow, John R. Whitney, N. S. Bouton, F. J. Hecker and E. B. Tippett. It was the province of these gentlemen to confer with the Master Mechanics and Master Car Builders Association on the subject of mileage and physical test, and upon a request from our Association the two Railway Associations appointed a special conference committee to meet with our committee and formulate, as far as practicable, specifications for a uniform guarantee and physical test.

The joint Committee met at Baffalo, N. Y., May 30th, 1888. the railroad interest being represented by such able men as Messrs. Lauder, Kirby, and Stevens. They were in session all day, and every point bearing on the subject was thoroughly discussed; the result was the unanimous adoption of the following, which

was recommended to each organization for their adoption and approval

"A JOINT meeting of the conference committees of the AMERICAN RAILWAY MASTER MECHANICS and the MASTER CAR BUILDERS ASSOCIATIONS, and the Executive Committee of the ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS, was held at the Genesee House, Buffalo, New York, at 10.30 A.M., May 30th, 1888. The following members were present: Messrs. Lauder, Kirby, and Stevens, of the railroad committees, and Messrs. Barnum, Bowler, Hecker, Lobdell, Snow, and Whitney, of the wheel-makers association.

On motion, Mr. W. H. Barnum was called to the chair, and Mr. Lobdell acted as secretary.

On motion, the specifications for chilled cast-iron wheels, as recommended by the Executive Committee of the wheel-makers association, were taken up for consideration. After a full discussion of the same,—each article being acted on separately, the following was, on motion, adopted, and was recommended by

the joint committee to the associations named above for their consideration and adoption.

Specifications for Cast-Iron Wheels.

1. The chills in which the wheels of any one wheel maker are cast shall be of equal diameters, and the same chill must not vary at different points more than one-sixteenth of an inch in diameter.

2. There shall not be a variation of more than one-half inch in the circumference of any given number of wheels of the same nominal diameter, furnished by any one maker, and the same wheel must not vary more than one-sixteenth of an inch in diameter. The body of the wheel must be smooth and free from slag or blow-holes. The tread must be free from deep and irregular wrinkles, slag, chill cracks, and sweat or beads in the throat which are one-eighth of an inch or over in diameter, or which occur in clusters of more than six inches in length.

3. The wheels broken must show clean, gray iron in the plates; the depth of pure white iron must

not exceed seven-eighths of an inch or be less than three-eighths of an inch in the middle of the tread, and shall not be less than three-sixteenths of an inch in the throat. The depth of the white iron shall not vary more than one-fourth of an inch around the tread on the rail line in the same wheel.

4. For each hundred wheels which pass inspection and are ready for shipment, one representative wheel shall be taken at random, and subjected to the following test:

The wheel shall be placed flange downward on an anvil block weighing not less than seventeen hundred (1,700) pounds, set on rubble masonry at least two feet deep, and having three supports not more than five inches wide for the wheel to rest upon. It shall be struck centrally on the hub by a weight of one hundred and forty (140) pounds, falling from a height of twelve (12) feet. Should this wheel stand five (5) blows without breaking into two or more pieces, the hundred wheels shall be accepted.

Or, wheels must be of such strength that 550 to

575 pound wheels shall require twenty (20) blows, and 575 to 600 pound wheels shall require thirty (30) blows of a hundred (100) pound drop falling seven (7) feet on the plate close to the rim to break a piece out,—the wheel resting upon a cast-iron plate weighing not less than one thousand (1,000) pounds.

5. Should in either case the test wheel break into two or more pieces with less than the required number of blows, then a second wheel shall be taken from the same lot and similarly tested. If the second wheel stands the test, it shall be optional with the inspector whether he shall test a third wheel or not. If he does not so elect,—or if he does, and the third wheel stands the test, the hundred wheels shall be accepted.

The above tests shall apply to standard weight wheels from 26 inches to 42 inches diameter, used on standard guage roads.

6. Wheels shall not vary from the specified weight more than two per cent.

7. The flange shall not vary in the same wheel more than three-thirty-seconds of an inch from its mean thickness.

8. The single plate part of a 33-inch wheel, known as the Washburn pattern, shall not be less than five-eighths of an inch in thickness in a wheel weighing from 550 to 575 pounds, and not less than three-fourths of an inch in thickness in a wheel weighing from 575 to 600 pounds.

Guarantee.

This Indenture, made this ——— day of ——— 18—— by and between ——— ——— party of the first part, and ——— ———, party of the second part, **witnesseth:**

1.—The party of the first part hereby agrees to furnish to the party of the second part, free on board cars at ———, ——— chilled cast-iron wheels, —— inches in diameter, under the following conditions:

2.—The party of the second part hereby agrees to pay to the party of the first part ——— dollars

for each wheel furnished, and to keep an accurate record of the mileage made by the wheels placed in service under cars in passenger equipment and under locomotives and tenders, and an accurate record of the number of months of service of the wheels placed in service under cars in freight equipment.

3.—The party of the second part hereby agrees that when any wheel furnished under this contract is scrapped, to furnish to the party of the first part a statement which will show

1.—The wheel number.

2.—The service in which the wheel ran.

3.—The amount of service in months or miles.

4.—The cause of failure.

5.—A charge against the party of the first part of fifty-five per cent. of the price of the wheel when mentioned above.

6.—A credit to the party of the first part of ——— cents per 1,000 miles for 36″ passenger equipment,

A credit to the party of the first part of ——— cents per 1,000 miles for 33″ passenger equipment,

A credit to the party of the first part of ——— cents per 1,000 miles for 30″ passenger equipment,

A credit to the party of the first part of ——— cents per 1,000 miles for 36″ locomotive and tender equipment.

A credit to the party of the first part of ——— cents per 1,000 miles for 33″ locomotive and tender equipment,

A credit to the party of the first part of ——— cents per 1,000 miles for 30″ locomotive and tender equipment,

A credit to the party of the first part of ——— cents per 1,000 miles for 28″ locomotive and tender equipment,

A credit to the party of the first part of ——— cents per 1,000 miles for 26″ locomotive and tender equipment,

A credit to the party of the first part of ——— cents per month for 36″ freight equipment,

A credit to the party of the first part of ——— cents per month for 33″ freight equipment,

A credit to the party of the first part of ——— cents per month for 30″ freight equipment.

Except in the case of wheels made flat by sliding, or removal for sharp flanges or other unfair treatment, which have not made sufficient service to balance the charge against the party of the first part as above; in such case a service credit shall be made which shall balance the charge.

4.—The party of the first part hereby agrees on presentation of the statement above mentioned, to pay to the party of the second part any balance due from lack of sufficient service on the part

of the wheels (with above exceptions) to balance the charge; and the party of the second part hereby agrees to pay to the party of the first part any balance due as shown by the aforesaid statement,—settlements to be made quarterly. It is, however, understood and agreed that no credit shall be allowed for excess of mileage for time service on freight wheels beyond the time guaranteed.

5.—The party of the second part hereby agrees to hold subject to the inspection of the party of the first part, for a period of thirty days after the said statement has been rendered, any wheels (with above exceptions) which have not earned for themselves a credit equal to the amount charged against them.

6.—It is understood that the basis for settlement shall be as follows:

36 inch passenger wheels . 70,000 miles.
33 inch passenger wheels . 60,000 miles.
36 inch engine and tender
wheels . . . . . 60,000 miles.

33 inch engine and tender wheels . . . . . 50,000 miles.
30 inch engine and tender wheels . . . . . 45,000 miles.
26 and 28 inch engine and tender wheels . . . . 40,000 miles.
Refrigerator, through line and cattle cars . . . . 24 months.
All other freight cars . . 48 months.

On motion the meeting adjourned.

Method of Computing Cost of Wheel Service.

In adjusting the price at which a scrap wheel should be charged back to the maker, either for the purpose of charging the short mileage or crediting the excess over the guarantee, it is understood that forty-five per cent. of the price at which the wheel is sold would represent its value as old material, and fifty-five per cent. would represent the actual cost to the railroad company.

Now suppose, for illustration, that a 33-inch passenger car wheel, weighing from 550 to 560 pounds, and guaranteed for 60,000 miles service, is sold for $11. When that wheel is scrapped, 55 per cent. of its first cost, or $6.05, is charged back to the maker. As an offset to this charge, the maker receives a credit for the service that the wheel has performed. On the foregoing basis of price, the rate of credit is ascertained by dividing $6.05, the actual cost of the wheel to the railroad company, by 60,000, the guaranteed mileage,—making 10.083 cents per 1,000 miles of service; at this rate, if the wheel made but 50,000 miles, the maker's credit would be 50 times 10.083 cents, or $5.04. As the wheel cost the railroad company $6.05, according to the terms of the contract the maker would have to pay the difference between $6.05 and $5.04, the amount of service performed, or $1.01.

Any excess of mileage that the railroad company had to pay the wheel maker would be computed on the same basis."

At the time these specifications were formulated, $11.00 was considered a fair price for a 33 inch passenger car wheel, guaranteed for 60,000 miles. It is not an arbitrary price, but is used only to illustrate the method.

The actual price paid for the new wheel would, of course, be used in ascertaining the cost per thousand miles, and the amount to be charged for deficient mileage.

The specification of this joint Conference Committee was immediately endorsed and accepted by the Association of Manufacturers of Chilled Car Wheels, and at the annual meeting of the American Railway Master Mechanics Association, held at Thousand Islands, June 19th, 1888, they were adopted without any change whatever, except in the order of arrangement of the several clauses. The Master Car Builders Association did not take final action on them until their annual meeting held at Saratoga, N. Y., June 25th, 1889, when they were adopted in the main, with but slight changes.

The Association has reason to extend its congratulations to railroad officials as well as to its own members, on the result of its labors in this direction. There is much more uniformity in the matter of guarantee and physical test, and the acceptance by the several associations of the recommendation of the joint Committee has given a basis upon which the replacement of defective wheels can be and has been equitably adjusted, and is conclusive evidence that whilst railroad officials have the right to expect that the mileage guarantee of wheels shall be made good, they are willing to admit that manufacturers are entitled to compensation for material furnished, and in matters of replacement are disposed to allow credit for actual mileage made. This is all that manufacturers can ask for, and justifies them in their expectation that the confidence and courtesy which have been extended to them by railroad officials through many years of business intercourse in the past, will be continued in the future.

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