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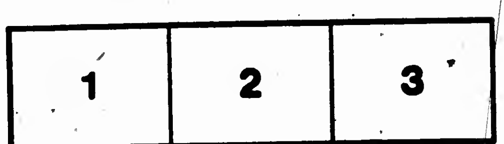
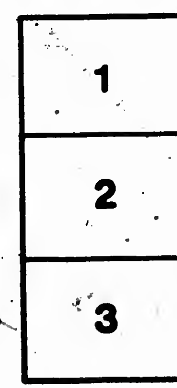
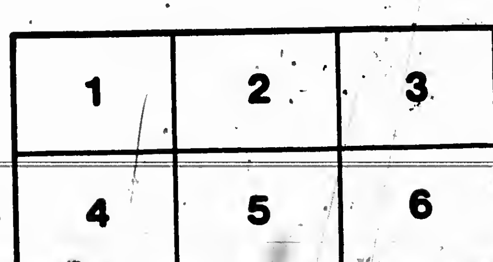
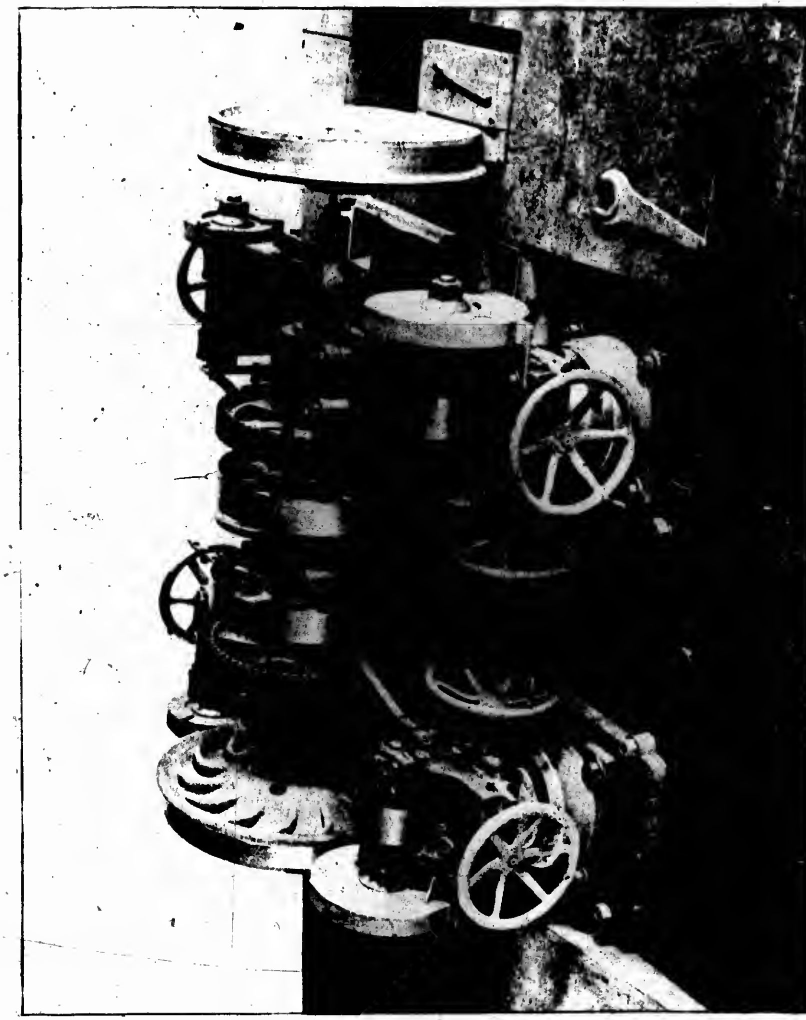






"MACHINED" CAR WHEELS

ST. THOMAS CAR WHEEL CO., LIMITED.
ST. THOMAS, ONT CANADA.



"MACHINED" CAR WHEELS

PATENTS

SEPTEMBER 13, 1881; JANUARY 9, 1883; JULY 1, 1884; JUNE 4, 1889; JULY 22, 1889; SEPTEMBER 17, 1889; OCTOBER 29, 1889; DECEMBER 2, 1889; JANUARY 21, 1890; JANUARY 22, 1890; FEBRUARY 11, 1890; FEBRUARY 26, 1890; MAY 6, 1890

ST. THOMAS, ONT., CANADA

THE ST. THOMAS CAR WHEEL CO., LIMITED

1890

PRESS OF CHARLES K. ALLEY, NEW YORK.
3739

Can a Perfect Car Wheel be made? If so, what must be its distinctive features?

TO SOLVE these questions we commenced a work some seven years ago that has grown to great proportions and produced results that speak for themselves in answer. A perfect car wheel must be absolutely safe, mechanically perfect and economical for service. What we have done toward attaining these ends may be determined by the fact that out of a total of five hundred thousand wheels made in the past five years and put into every kind of service on the leading railroads of America, not one case of breakage has occurred, that we command the means for furnishing wheels in an absolutely perfect mechanical condition, and that we can supply such wheels at the ordinary market price paid for good chilled car wheels. That the work we have done may be appreciated, we will explain the details and also give some general facts concerning car wheels and their use.

The subject of car wheels is a very vital one to railroads. The annual expense for renewals exceeds that of any other item of railroad supplies.

The chilled car wheel made from charcoal pig-iron is used exclusively under freight cars and under at least seventy-five per cent. of the passenger cars and locomotives of America. It may be thought that the use of steel wheels is more extended; but the estimate given is based on careful investigation. On many of our leading railroads, notably the Pennsylvania Railroad, the chilled wheel is used almost exclusively. We have not confined ourselves to a study of the possibilities and results of chilled wheels alone, but have given equal attention to those obtained from steel wheels, with the intention of determining the questions we have asked on the first page of this pamphlet in a thorough manner.

ABOUT seven years ago we commenced making tests (chemical and physical), in a limited way to ascertain facts in relation to the character of our wheels. These tests were comparative; that is, they were made during and after the process of manufacture, and were intended to give us such information regarding the quality of our wheels as would enable us to conduct their manufacture on some other basis than that of obtaining a knowledge of their exact quality in service. We desired to know this to an absolute degree before delivering them for service. These tests were extended and perfected in the course of time and finally brought to cover every wheel manufactured by us, in an individual manner. Means were taken to distinguish and identify each wheel, so that five years ago we had reached the point where every wheel made was subjected to six separate tests, giving full information of all details regarding their quality and character. Standards for inspection and acceptance were then established which would in our experience produce a safe wheel as stated. The results of this labor speak for themselves: **not**

one wheel delivered by us for service has ever broken out of the wheels made by us during that time—this out of a total of over five hundred thousand wheels put in service on leading railroads. The standards referred to were determined by the experience of many years in what conditions were necessary in a first-class wheel. The results of these tests, carried on unremittingly with the manufacture of every wheel, gave us further knowledge of the possibilities of wheel manufacture. The all-important question of safety was determined, all other conditions being correct, by the strength of the iron obtained from our mixtures.

For the best ordinary work this standard of strength may be expressed by a load of 2,800 pounds required to break a bar one inch square by twelve inches long made from the mixtures of iron used in the wheels, this load of 2,800 pounds being placed upon the center of the bar to break it. A bar of this size carrying a load of 2,000 pounds would be considered very strong ordinary iron, but as 2,800 pounds was the best average obtained from mixtures on our first trials, that was established as the limit of strength. Our work in this field resulted in obtaining mixtures that would give a bar of the size referred to carrying a load of 3,000 pounds. Further work resulted better; we obtained bars carrying 3,200 pounds, 3,300 pounds, and so on, step by step, up to 4,000 pounds, as a regular and positive result obtainable from certain mixtures. We have lately made bars (same size) carrying a load of 5,000 pounds, but this is exceptional. Mixtures giving test bars with such extraordinary strength are not only made from the highest grades of iron, but from special lots of iron of these grades manufactured expressly for us, and which lots are subject to rejection unless they give certain results in the tests made of the iron when received. We believe that if our regular standard wheel, made during the past five years with the result as stated—not one case of breakage—can be still further improved on in the important particular of strength, and we can make wheels on a standard fifty per cent. higher, that such wheels will be absolutely safe.

In the effort to improve the manufacture of our wheels attention was early drawn to the great necessity of providing some means for overcoming the mechanical imperfections. The conditions of service were constantly increasing in severity, and the life of the wheels decreased because they were put in use with no further preparation than that of being fitted on axles. Much was done to improve our wheels by care in the method of manufacture, but the unavoidable difficulties of foundry practice, the shrinkage of metal and the strain on the mold in the process of casting, caused the wheels to be out of round and balance. It was, therefore, impossible to manufacture, as a product of the foundry, a mechanically-perfect wheel.

It is a well-known fact that the great majority, perhaps seventy-five per cent. of the wheels removed from service, are taken out on account of defects arising from the use of brakes. As the speed of trains is now being increased and as the use of air brakes on all trains, both freight and passenger, is only a question of time, it follows that the conditions for braking must be improved, or the expense for wheels, on account of the higher speeds and more extended use of air brakes, will be a constantly-increasing one. When the brakes are applied to a wheel that is not round the variation in pressure between the high and low places is exceedingly great, and when the brake engages the wheel at its highest point it is very apt to stop and slide it, producing a flat spot; if the wheel is not removed, after a short time the iron shells out at this point, and then it must be removed on account of its general imperfections.

With perfectly true wheels the pressure of the brakes is equalized and the application of braking power may be increased without liability to slide wheels.

Machines had been constructed for turning and grinding wheels after they were placed on axles, but the work being slow and expensive, it was found impracticable when carried to any extent; the cost of finishing wheels on them was greater than that of the labor required for their manufacture.

After a careful study of the subject, we concluded that the wheels should be finished before being placed on axles, for the reason that each wheel could be treated for its own defects and the work be done by the wheel maker. When wheels were finished on axles the defects in rotundity were never at the same point in both wheels, and to insure equal diameters it was necessary to grind more from one wheel than from the other. To finish wheels on the axle made it impossible for the wheel maker to do the work, as not one per cent. of the wheels used are furnished by the maker fitted in that manner.

For three years we built, took apart and rebuilt machinery designed for this purpose. We finally reached the form of machine now used by us and which is shown on the first page of this pamphlet.

Our process with each wheel is to bore it out in the usual manner and then to place it, by means of suitable attachments, on the self-centering mandrel of the grinding machine.

When the grinding attachments are brought into position and the emery wheels properly adjusted the work of the machine is automatic until the wheel is ground true. Two wheels are placed on the machine and operated on independently, the adjustment of one being made by the attendant after the other is in position.

The average output of one machine in ten hours is fifty wheels, although we have finished sixty in the same time. There is but one attendant to each machine and the work can be done by any intelligent laborer. These results may be seen in our works at any time. They have been steadily obtained for the past year.

After the wheels are removed from the grinder they are placed on the balancing machine and tested. The methods for correcting the balance will be described hereafter. The wheels are then gauged to diameters by sixty-fourths of an inch and are ready for service, mechanically perfect.

The advantages to be gained by the use of "machined" wheels are so apparent that it will not be necessary to dwell at length upon them. A few facts may be stated, however:

The increase in the life of cars and permanent way, and the decrease in the power required to haul trains on account of the more perfect running of the cars, the increased mileage to be obtained from the wheels, due to the fact that the life of any machinery, whether it be a car wheel or anything else, is always increased by mechanical perfection—all are matters which will be readily understood by any practical railroad man.

They can be gauged to exact sizes. The importance of uniformity in this is best illustrated by the fact that in one mile, with a pair of wheels that vary in diameter but one-sixteenth of an inch, the larger wheel will travel nine feet more than the smaller one, and this variation must be overcome by dragging or pulling the smaller wheel and the sliding or retarding of the larger one against the companion rails.

In making one-sixteenth of an inch the basis of this comparison we are taking the smallest possible limit that can be obtained with ordinary cast-iron car wheels and ordinary conditions under which they go into service. The Pennsylvania Railroad specifications were first drawn with the requirement that wheels should be true to one-sixteenth of an inch, the test being made with an iron ring placed over them. This, however, was found impossible in practice and was afterward changed to a possible variation of three thirty-seconds of an inch. As the metallic ring placed over the wheel would require at least one sixty-fourth of an inch all around to admit of its being placed on and taken off, it follows that the ordinary wheel cannot be made true within one-eighth of an inch. Boring the wheels first, as we do, and then grinding them, insures an absolutely true relation between the bore and the circumference, with all the consequent benefits as compared to a wheel the circumference of which does not bear a true relation to its center. In boring the ordinary wheel it is centered from its circumference, which, being admittedly untrue, makes it impossible to bore it to a true center. This variation in ordinary methods not only causes an eccentric motion in the wheel, but throws it out of balance. Let us suppose a train in motion at the rate of thirty miles per hour. In such a case a wheel will make 306 revolutions per minute. If it is ten pounds out of balance there would be a variation in the weight of metal moved through the circle described by the circumference equivalent to 3,060 pounds per minute. There are eight wheels under a car. The total variation would be upward of 25,000 pounds. The effect of this on the cars and track can be easily estimated. Ten pounds is not a high estimate for an amount out of balance as wheels are ordinarily used, for in addition to what is created by imperfect fitting we must consider the unequal distribution of metal in the wheel consequent on the conditions of foundry practice. A casting weighing a quarter of a ton cannot be turned out of a foundry mechanically perfect in this respect. We have found many wheels in our tests of various makes that are double that amount and some that are even treble. Now, we take again for comparison a car equipped with wheels that vary in diameter as well as balance and which are within the Pennsylvania's specifications. (Which specifications have been adopted by the Master Car Builders' Convention as a standard in respect to rotundity.) The effect of the rising and falling of the car, the motion caused by the varying weight heretofore referred to, and the irregular pulling of mismated wheels, produce a result which need not be an imaginary one; it can be easily ascertained by riding on a freight train operated under ordinary conditions. To what extent the cost of operation may be lessened, by improving the conditions referred to, is a matter for investigation. As a proof that there is ample ground for improvement, let us sum up the result of moving a car one hundred miles. There are four pairs of wheels, each of which must be pulled forward or backward nine feet in each mile. This movement is entirely independent of the motion of the train and is unavoidable. In one hundred miles this makes a total of three thousand six hundred feet. If a car travels at the rate of thirty miles per hour, it would take three hundred and twenty minutes to cover one hundred miles, and if a weight of twenty-five thousand pounds per minute must be moved, as shown, a total weight of four thousand tons must be moved in one hundred miles. This is the result on one car only.

There are some peculiar conditions existing in the manufacture and use of the chilled wheel which we believe can be improved upon. A guarantee of service is given for the standard-sized (33-inch) wheel — fifty to sixty thousand miles or its equivalent in time service. This guarantee is supposed to hold the maker responsible for failures due to defects inherent in the wheels. Failures occur from a variety of causes, many of which are ascribed to the wheels, but which are really due to the conditions of service. It is probable that three-quarters of all wheel failures are caused by brake service and its results on the wheels.

As the chilled wheel is ordinarily used without being true and round, the application of brakes generally results in sliding the wheels to a greater or less extent. No matter how short the time in which they are slid, the friction, intensified at the point of contact with the rail, produces a flat spot, and the heat developed destroys the life of the chilled iron at that point. When the wheel is again in motion, running at a speed of thirty miles an hour, the flat spot strikes the rail three hundred and six times per minute. The load on each wheel is from five to eight tons. In a short time the iron at the flat spot shells out and the wheel is rendered unfit for service. If this flat spot is a particularly bad one the wheel is removed from service before the shelling-out process begins, and is not considered as failing on account of inherent defects. If, however, the flat spot is not large the wheel remains in service; another spot soon results, and the process goes on indefinitely, until often the entire tread of a wheel is covered with defective spots and has then, in the opinion of some inspectors, failed for inherent defects, which are described as "sand holes" in tread, "crumbled out," "shelled," etc.

The competition among wheel makers has no doubt prevented them from bringing these matters as strongly before the railroad managers as they would be warranted in doing. Some railroads carry the enforcement of the guarantee to a rigid point and get a large portion of their wheel supply gratis through the eagerness of wheel makers to accept orders on any conditions. It is a common remark by railroad men that they want nothing unfair, but that wheel makers are largely to blame in soliciting and accepting orders on any conditions that will secure them. All wheel makers know that many wheels are returned to them which show no cause for removal, and it is the practice of many railroads to condemn both wheels of a pair when one fails. The railroads would apparently be benefited by such a state of affairs, as they receive wheels on guarantee account without charge; but it is a question if they are benefited at all by any condition that is unfair, whether imposed with their consent or not. They may profit by removals on their own cars when on their own line of road, but in case of removals abroad they are heavy losers. The guarantee is not held to cover any damage arising from wheel failures. If a wheel breaks in service the owner is entitled to demand a new wheel for the defective one, but as the damage may run from one to one hundred thousand dollars and over, the guarantee is in such cases no protection to the railroad. This is a very unsatisfactory and expensive condition of affairs for the wheel makers and for the railroad companies, and all will agree that if a means can be found to remedy the difficulties it will be worthy of every consideration.

The universal feeling among railroad men to-day is that they must have the safest wheels they can buy, without regard to cost. This is demonstrated by the fact that many are paying from four to six times as much for steel wheels as similar diameters of cast-iron wheels can be procured for.

The very satisfactory results obtained led us some two years ago to take up the manufacture of wheels of larger diameter than 33 inches. During the past year we have made and put into service wheels 36, 40, 42 and 43 inches in diameter, the respective weights of which are 750, 1,000, 1,100 and 1,200 pounds. We have made these wheels of a weight corresponding with similar diameters of steel wheels as an additional factor of safety, and because it is possible for us to preserve with any weight perfect mechanical conditions regarding balance and rotundity. Some trials have been made heretofore with large-diameter cast wheels which have resulted unsuccessfully. This was partially due to the fact that the wheels were made too light and that it was impossible for the makers of them to increase the weight to any great extent on account of the liability of producing imperfect conditions of the wheels themselves in regard to their being out of balance and out of round. We have preferred to move slowly in the matter of introducing these large-diameter wheels and to ascertain from the results of actual service the satisfaction they might give. So far, that result has been all that could be desired. Cars equipped with them ride as smoothly (if not more so) than those equipped with steel-tired wheels. The price of these wheels is not intended to be competitive with the price at which other cast-iron wheels of similar weights can be obtained, but the price is determined by what it costs us to produce the very best thing in the shape of a cast-iron wheel that we can make. So far as our experience goes, we have every reason to claim that such wheels are superior in point of safety to any description of steel wheel. We are well aware that many railroad men look upon the use of cast wheels under passenger cars and locomotives as a practice not up to the best standards of safety, but they generally class all cast wheels as of one quality and judge all alike.

To give an idea of the difference between the special and the ordinary wheels, we may state: Taking the Pennsylvania Railroad and Master Car Builders' specifications as a basis of strength for good ordinary wheels, we guarantee these special wheels to stand five times the test required by the Pennsylvania Railroad and Master Car Builders' rules in the matter of strength.

If the special wheels of our manufacture receive the same treatment accorded steel wheels, with the machinery we now have in service, they can be treated in exactly the same manner as steel wheels, at less cost. If they are removed from service in the case of brake-sliding they can be re-turned on our machinery at less cost than a steel wheel could be re-turned in a lathe. It is well known that a given body of chilled iron will give greater proportionate wear than the same body of steel, as chilled iron is much harder. As these wheels are chilled to a depth of three-quarters of an inch all around the tread, or a total of one and one-half inches throughout, it can be seen that an inch of wear can be taken from them if they are removed from service and re-turned when necessary. They have not been in service long enough to determine the greatest possible mileage that can be obtained, including this re-turning, but we believe it will be greater than any steel-tired wheel yet produced has given.

We state these facts, not as a new discovery we have made in our manufacture, but as the result of many years of hard labor and of experiments and tests conducted without regard to cost, with the idea of producing a perfect car wheel. During the past five years we have expended upward of one hundred thousand dollars in this work, and we have actual records in our various establishments of upward of seven millions of tests made in connection with the manufacture of our wheels during that period. When we are able to state that we can take any wheel made during that time, without regard to whom it was made for or the service it was intended for, and show upon it distinguishing marks by which we are able to positively identify the wheel as an individual thing, and then turn to our books and show the tests referred to with relation to it, the far-reaching and comprehensive character of our work during the period mentioned may be appreciated.

METHODS OF BORING CAR WHEELS.

The process of boring car wheels for the axle is a short one, yet it is of the greatest importance that it be done correctly. Common practice in doing this particular work varies from the carefully-managed shop with first-class tools and competent workmen to the worthless tools and incompetent workmen too often found.

The process of boring chilled wheels is made more difficult than similar work on ordinary cast-iron by the fact that the iron in the wheel is necessarily of a hard and tough nature in strong well-chilled wheels. The difficulties encountered in the work are well known to practical railroad men.

When the wheels are difficult to bore the steel cutters lose their cutting faces very quickly and good work cannot be done with them. At times it is necessary to remove and dress the cutters for every few wheels bored. Of course the work can be done in a sort of way without the exercise of care in this particular, but the result is irregular boring and imperfect work. Safe practice and good workmanship require two cuts through a wheel hub, the first to take out the hard face of the bore and to leave clean metal for the tool taking the second cut.

The boring bars of wheel-boring mills are generally constructed to take a steel cutter having two faces from one to one and a half inches wide; sometimes cutters with four cutting faces of this width are used. Attempts have been made to use cutters of chilled iron instead of steel, to save the constant expense of making and fitting the steel tools, but the brittle nature of the chilled metal prevented successful working in tools of the shape required. We have designed a form of chilled cutter or reamer (Fig. 1) possessing the following advantages: It has six cutting faces, each four inches long, or twenty-four inches of cutting face altogether. As will be seen, it works on the principle of a reamer, and its large bearing in the bore as the work is done prevents irregular boring, for reasons readily understood.

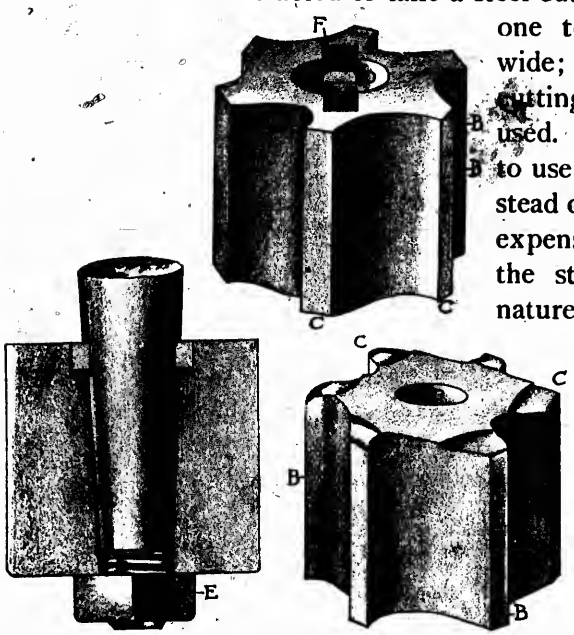


FIG. I.

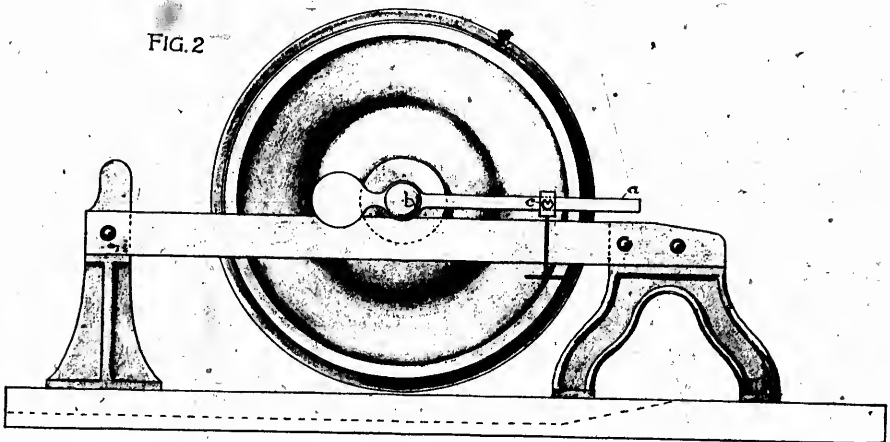
The heaviest work with the chilled reamer is done on the lower edges, *z*, of the wings, *b*. These edges can readily be sharpened on a small emery grinder when at all dull, still the correctness and perfection of the work does not depend on the cutting edges, *c*; it is regulated by the cutting faces, *b*, which follow through the bore, and on account of not coming in contact with the rougher and heavier part of the work (done by the edges, *c*,) make the bore perfect in every respect. These reamers are provided with a tapered hole, *d*, which admits of their fitting over a similar shaped end fitted to the boring bar. The nut, *e*, being tightened, the reamer is locked into position by small lugs on the boring bar fitting into similar recesses, *f*, in the reamer. In ordinary practice, from twenty to thirty wheels can be bored before the edges, *c*, require sharpening, which is done in a few minutes by hand on a small emery wheel, located convenient to the boring mill. From one hundred and fifty to two hundred wheels can be bored before the edges, *b*, require sharpening. This is done by placing the reamer over a suitably tapered plug fastened to the face plate of a small lathe, and doing the work with a small emery wheel attachment to the lathe generally found in machine shops.

For work to given sizes the reamers are ground to specific diameters. For general work, where it is the intention to re-bore or take a second cut, they are simply sharpened and used indiscriminately between certain sizes. For instance, on an order for four-inch core, wheels can be bored from four and one-half down to four inches and be suitable for re-boring by the user for all purposes the four-inch core might have served. We have chilled reamers used in this manner with which we have bored with each one upward of two thousand wheels.

With the use of these reamers on boring mills in good condition it is impossible to crowd the work of wheel boring so as to do it improperly. More work can be done than with the use of steel tools. The use of expensive steel tools and the cost of maintaining them is dispensed with. The character of work that can be done with a chilled reamer is far above that done with the ordinary boring tools, for reasons that will be readily understood by any mechanical man. We can furnish these reamers in any shape and size. They are very suitable for general machine work on pulleys, car brasses, milling machines, etc. Further particulars in regard to the use of these tools will be furnished on application.

METHODS OF BALANCING CAR WHEELS.

FIG. 2



After many trials of different devices for and methods of balancing chilled wheels the following was adopted:

In the manufacture of each wheel small lugs are cast upon the plate, preferably between the brackets or arms on the flange side. They may be cast at any other point on the wheel. Each lug has a three-quarter inch tapered hole formed with a core in the usual manner.

Fig. 2 shows the device used for testing wheels for balance. Fig. 3 is an end view of the same. *AA* are parallel bars with upper surface beveled down at one end to allow the wheel with mandrel inserted to be readily placed upon them. *CC* is the expanding mandrel which is placed in the bore of wheel and tightened by means of hand wheel, *D*. The lever, *a*, fits neatly over one end of the mandrel and may be secured in any position by the thumb screw, *b*.

After the wheel is bored and ground the expanding mandrel is inserted and the keys expanded by turning the hand wheel. The wheel is then rolled between the parallel ways and supported by the projecting ends of the mandrel bearing upon them. The heaviest part of the wheel is at once located in the usual manner and marked. The lever, *a*, is turned in line with the mark and the thumb-screw, *b*, tightened to secure the lever in this position. The wheel is then turned so that the lever stands horizontally and in line with the point at which weights must be added. The slide, *c*, is adjusted at the point of diameter where the balancing weights are to be attached. Marked weights are then placed upon the slide, *c*, and the exact weight necessary to balance is ascertained. Balancing blocks of suitable shape are made as per Fig. 4. These blocks are cast of different weights, indicated by figures cast upon them, and are provided with a recess to fit over the lug, *d*, and a cored hole, *e*, through which a rivet may be passed. A block of proper weight is placed over lug, *d*, at the proper point, and a three-quarter inch

FIG 3

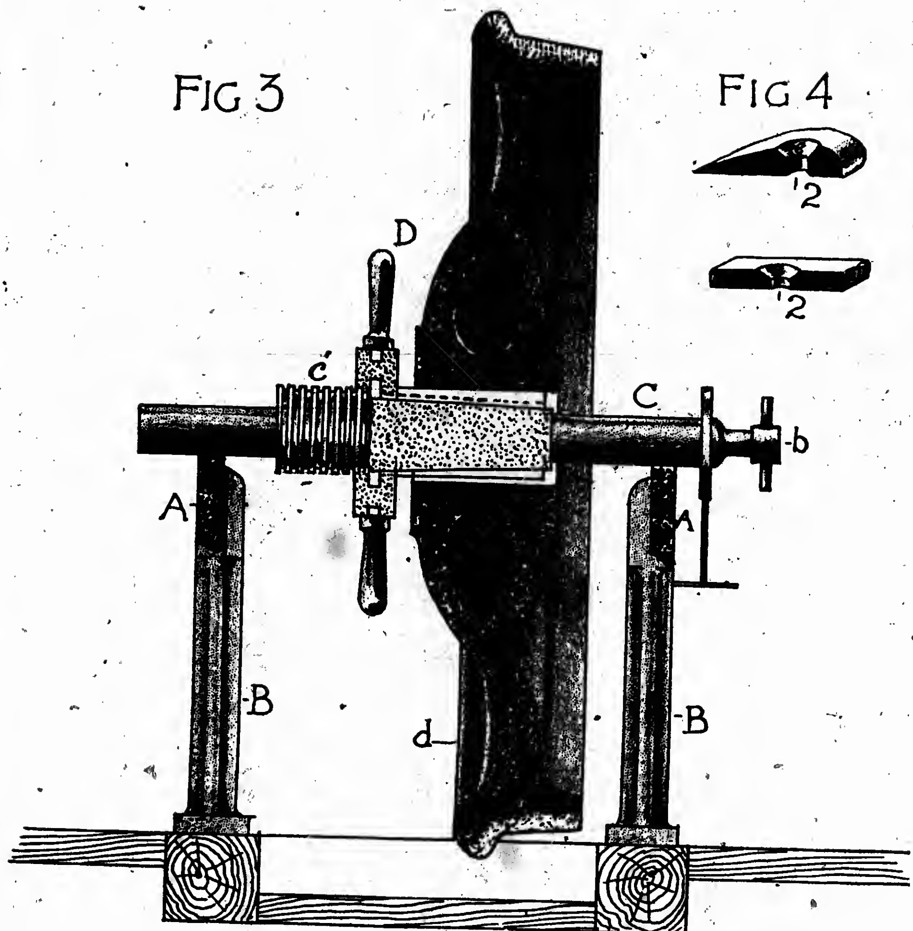


FIG 4

rivet with heated end is passed through the block and enters the tapered recess in the lug, *d*. The rivet is driven home, the heated end upsets and the balancing block is securely fastened in place. When the blocks are placed between the brackets or arms they are out of the way and can be firmly secured and held in position. It will be noted that the important feature of this method of securing the balancing blocks is that nothing is done to impair the strength of the wheel in attaching them. No holes are bored through the plate from which cracks may start when severe strains are put on the wheels in service.

AS SHOWN by the results set forth, we believe a work has been done which will commend itself to all railroad men. We have awaited the result before claiming it, and now are able to show by the evidence of half a million wheels in service on the leading railroads that safe wheels can be made when they are made under proper conditions. No better argument of the importance of that fact can be given than to cite the case of four of our leading trunk lines. Two of them have used the wheels made in the manner described during the past five years. During that time not one life has been lost nor one dollar of damages incurred through their use. On the other two railroads, during the same period, over fifty lives have been lost and over two million dollars paid out from this one cause alone. From every standpoint of responsibility, economy and good management, evidence of this kind deserves attention. It would be impossible to give in the space available all the information necessary to explain the work we describe, but it will give us pleasure to lay fully before those interested all the particulars of the subject.

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