The Ultimate Motor Truck Wheel

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INDEX

FOREWORD

THE main purpose of this book is to point out the remarkable progress that has recently been made in the development of wheels for motor trucks. The proposition has such a tremendous scope and the effects will be so far-reaching, that it is bound to vitally influence the future of the truck industry.

Now that the World War is over, and the enormous capacities of our American factories can again be used for commercial production, the great period of reconstruction is in full swing. It behooves all of us to delve deeply and be fully prepared for the many changes that will occur. This is no time for experiments, everyone wants means and methods which have been tested, tried and proven equal to the needs.

This book is contributed much in the nature of a warning to prepare *now*. It is all facts, no theories—it is the result of extensive research work—truck manufacturers, engineers, and sales managers, as well as large truck distributors, owners of truck fleets and tire manufacturers have been interviewed. Many months have been consumed in its compilation.

It is our sincere hope that a careful perusal will be of help to all interested in the manufacture, sale and use of Motor Trucks.

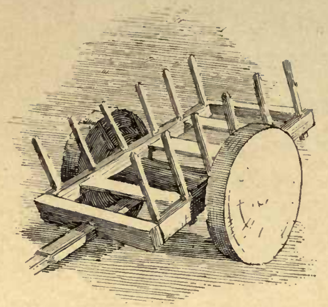
SECTION ONE

THE EVOLUTION OF THE VEHICLE WHEEL

VERY few people realize the great importance of the role performed by the wheel for vehicles in promoting present day civilization. It has proven to be one of the greatest of human inventions. Wheels of various types have existed for centuries. King Solomon had 1400 war chariots equipped with metal (bronze) wheels, and in the centuries that followed, the various half-civilized nations of the earth had carts and other types of vehicles equipped with crude wheels, mostly fashioned of wood—either cross sections of large tree trunks, or slabs of wood laid crosswise and joined together with the ends shaped in cylindrical form. Later there came into use wheels with wood hubs, spokes and rims, bound together with metal tires.

As with all other inventions, there was little progress until the nineteenth century, when huge strides were made. With the invention of the steam locomotive as a propelling force, it instantly became necessary to have new types of wheels that would withstand the stress of much greater speed, and heavier loads.

The great success of the steam locomotive was made possible only by the ultimate invention of a *flanged wheel* to run on a smooth track. Engineers and inventors, after several years of tests and experiments, finally evolved the present type of car wheel made solid of cast metal and flanged. As it is used on a *smooth track*, it meets requirements very satisfactorily.



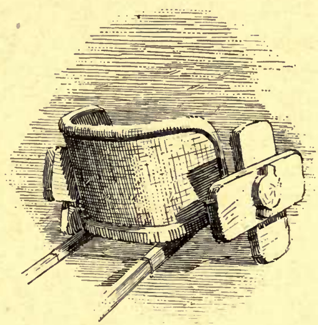
In the early part of the nineteenth century there was a profusion of second growth hickory timber in the U. S. which, because of its toughness and elasticity, was adopted as the most suitable material for built-up wheels for slow-moving carriages and trucks, drawn by horses or mules. There was always a weakness, however, in this type of wheel—in dry weather the wood parts would shrink, and the spokes become loosened where they joined the hub and felloes, which, together with heavy loads and sudden blows from rough roads, would cause "flats" or a break-down of the wheel, necessitating extra cost of repairs and delays. With the advent of the passenger automobile, about the year 1900, the manufacturers largely continued the use of the built-up wood wheel thereon, with the addition of pneumatic tires, which tend to relieve the wheel of the great increase of road shocks due to vast increase of speed as compared with slow horse-drawn vehicles. Thus the air-inflated tires receive most of the abuse and protect the wheel from direct impact of rough roads.

Of late years, along with the tremendous increase in output of passenger automobiles, there is a growing scarcity of suitable timber, properly seasoned. Also improved types of wire and disc wheels are being exploited more extensively all the time for passenger automobiles.

The development and use of motor trucks in the U. S. did not keep pace with that of passenger cars. Not until the outbreak of the World War did the general public begin to realize the tremendous importance of the motor truck. In August, 1914, the different war boards of the Allies in Europe sent hurried calls to the U. S. for heavy-duty trucks. Their manufacture was instantly accelerated, and the demand from that quarter increased by leaps and bounds.

Without the use of motor trucks—which were used to rush all sorts of munitions and supplies to the front—the German invasion of France could not have been repelled. As our American factories of enormous capacity began to speed up the manufacture of all sorts of war supplies, and our railroads became more and more congested, the only relief in sight was more motor trucks. The manufacturers of trucks have met the greatly increased demands; so that now hundreds of thousands of motor trucks are being produced annually for commercial use in the U. S.

At the end of 1917, there was in commission in the U. S. a total of 300,000 motor trucks of all sizes and kinds. During 1918, there was produced and sold by U. S. manufacturers, 250,000 motor trucks, which shows the great increase in consumption. During the development of motor trucks, the built-up type of wheel was con-



tinued the same as on passenger automobiles, but as it has been necessary to use solid tires on heavy motor truck wheels, they do not afford as much protection to the wheel in lessening road shocks, as do pneumatic tires on passenger automobiles.

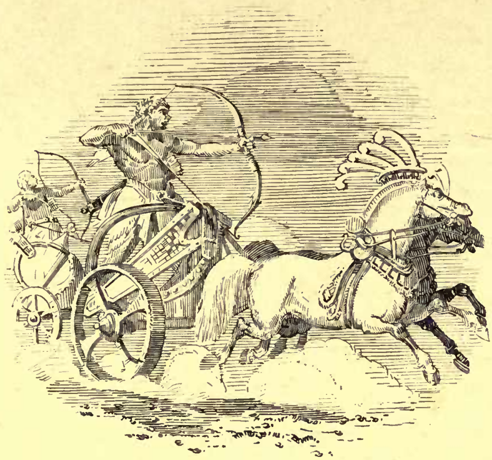
Thus with the constantly increasing speed and greater loads of motor trucks—the built-up type of wood and metal wheel is proving more and more unsuited to present-day conditions. The increased stresses and strains of rough roads and streets cause the spokes of wood wheels to loosen at the hub and rim, necessitating repairs, delays, and in many cases replacement of wheels.

Engineers who have given the most study to motor truck development, are practically unanimous in stating that *cast steel* when *properly designed* is the correct material to use in the construction of heavy motor truck wheels, in view of the stringent requirements today, for the wheel receives the most severe punishment of any part of the truck.

While the material for motor truck wheels is important, the design is more so. The great difficulty which had to be surmounted by the successful designer of a metal wheel was the provision of elasticity. Since road shocks can not be eliminated, they must be distributed and dissipated before they reach the axle. In a wheel not resilient, the road shocks are transmitted direct to the axle, minus that which is expended in overcoming inertia.

It has always been an easy matter to design a metal wheel which would sustain a heavy static load, or one which would move over a smooth surface, like a locomotive wheel which runs on a *smooth track*. The big problem for many years has been to provide a metal wheel which would dissipate shocks due to passing over *irregular surfaces* at *good speed*.

This problem now has been successfully solved by an automotive engineer in his perfection of the ultimate type of cast steel wheel, which provides for much speedier motor truck transportation.



SECTION TWO

THE MOTOR TRUCK WHEEL PROBLEM

MORE and more the built-up type of wheel is proving inadequate to meet the greatly increased demands of motor truck service. Cast steel is the most logical and suitable material for motor truck wheels.

The most vital requirements of the modern day motor truck wheel are the qualities of:

1—Resiliency or Elasticity.
2—Strength.
3—Durability and Economy.
4—Lightness.

While the material to be employed is very important, the design is even more so, in fact, the design is the crux of the entire proposition.

When engineers begin to calculate the loads, stresses and strains under varying conditions, the question of sizes, dimensions, shapes, and composition of the metal offer a wide field for differences of opinion. Only long experience will reveal and prove the correctness or incorrectness of engineering practice. The elastic limit of a piece of steel of known composition and treatment can be calculated, and the known load it will sustain can be determined.

The ratio of ultimate strength to the working stress, in engineering parlance, is called the "factor of safety." In wheel engineering the word "safety" has a deeper meaning than mere strength of material—it means human safety. The factor should be in general such as to bring the working stress within the limit of elasticity and furthermore to leave within that limit a margin which will be ample enough to cover such contingencies as uncertainty in the estimation of loads. The engineer must also consider the distinction between the steady, or dead loads, and loads which are subject to variation. With the former the working stress may reach or pass the elastic limit without disastrous results, but in the latter, a stress of the same magnitude would lead inevitably to fracture, and therefore a larger margin must be left to insure that the elastic limit shall not even be approached.

RESILIENCY OR ELASTICITY

Resiliency or Elasticity is of supreme importance and must receive very careful consideration in truck wheel construction. Excessive resiliency is not required. Resiliency is the power of metal to resume its original shape and size after distortion by the application of force. A solid iron or steel wheel is not resilient; as a mass it does not receive an impression, nor can its shape be distorted by shocks.

Wrought or malleable iron wheels have not the desired resiliency, though they may take impacts, but that only at the very point impact occurs, and but slightly return to their original shape when forces are released. They take a "set" very easily—the supports will receive almost the full force of the shock.

Resiliency or elasticity is rather obscure when applied to truck wheels because of the time element and manner of conception. The quality of resiliency is necessary in a wheel because it takes the edge off of excessive road shocks.

The elastic limit of steel depends upon the proper carbon content and proper heat treatment. A resilient wheel is less liable to develop cracks, because shocks are instantly transmitted over the entire wheel and thus lose their force at point of contact. In a wheel not resilient, the energy as represented in a road shock is transferred direct to its support, the axle, minus that which is expended in overcoming inertia. Road shocks and impacts can not be eliminated, so they must be distributed and dissipated by the wheel as much as possible before they reach the axle.

Therefore, the cast steel wheel so designed as to provide the proper resilient qualities, is the best adapted for motor trucks. Materials having a low elastic limit are not suited for truck wheels any more than is malleable or wrought iron suitable for springs. To illustrate this point, a wrought or malleable iron ring is struck a fifty pound blow while being held in position on an anvil by one's hand. The force will cause the ring to bend in the direction of the blow, and the hand holding the ring in position does not feel the stinging pain, as would be the case if the ring was composed of fairly high carbon steel. A steel ring when struck a similar blow in like position, vibrates to such an extent as to cause it to bounce on its support, and not bend or break. Because of the low elastic limit of wrought or malleable iron, the severe repeated shocks soon go beyond that limit, causing coarse grain or fractures.

It is more dangerous for ships near the shore where the waves break in case of storm, than out in the wide ocean where the waves do not break. The character of vibration in truck wheels at supporting point is much like the action of the ocean waves during a storm, because of stoppage of flow or course of vibration.

The prevention of metal fatigue or fracture is a *matter of dissipation* of shocks or vibrations. A cast steel motor truck wheel, which is subjected to the greatest abuse of any part of the truck, must "give" just enough to relieve the wheel of the fierce blows or road shocks. There must be no stoppage to the course or lines of vibration, nor should there be points or places where vibrations are excessive over other points. As much as possible vibrations should be dissipated in the wheel rim.

The following examples show the difference of resiliency and non-resiliency as in their relation to dissipation or absorption of vibrations:

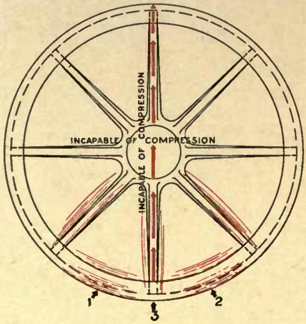
An iron suspension bridge is resilient. a paved road is not.

A wheel with hollow rim and five or seven not-directly-supported spokes is resilient and a disc wheel is not.

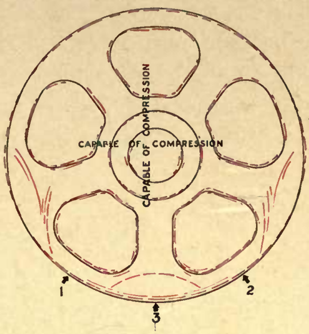
A shot fired from a battleship will not go as far as a shot fired from the same gun on terra firma.

A 12″ solid cube iron block on one's knee can be hammered on without feeling the hammer blows.

A 12″ hollow cube block with only $\frac{1}{16}$″ wall can be used the same way without feeling the hammer blows.

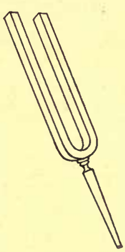


(*a*) *Shows in an exaggerated way, on the solid-spoke wheel, the effect of a blow between spokes. Note the bending action back and forth.*



(*b*) *Drawing slightly exaggerated, shows how the broadly flaring curves of the Dayton type of wheel gives the rim an elastic instead of a rigid support—how the uneven number of spokes slightly permits the displacement of the hub, protecting bearings and axles from the shock. Due to the design, a road shock on the Dayton Steel Wheel is not localized, but is taken up and distributed through the entire wheel structure.*

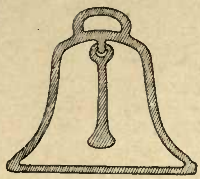
But when the metal of this latter hollow block is made into a smaller solid block, the same hammer blows would be rather painful. In the solid block the hammer blows are absorbed as a sponge absorbs water. In the hollow block the hammer blows are dissipated as the gong of a bell or the sound of a tuning fork.



A steel disc when hit on its edge will not sound as freely as when hit on its flat side.

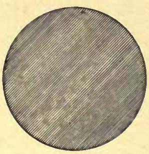
But as soon as you dish and change the disc into bell, this disc then will become resilient, providing, of course, we apply the term *resilient* to the bell.

Under resiliency is meant dissipation of shock energy, rather than absorption. If a bell were cast with the wide part closed up, the vibration would be short, therefore the ringing sound would be absorbed, but not dissipated. The same holds good with a tuning fork or a spring.



STRENGTH

In producing the perfect motor truck wheel, the question of strength must be given every consideration. The desired result can only be obtained by the proper use of the material best adapted—cast steel, so designed as to provide maximum strength.

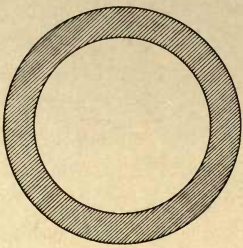


A

Referring to the diagrams, we assume that the steel has been properly heat-treated and desire to give it a shape that will enable it to withstand the greatest strain, not only vertical, but every other way. In what form will a given amount of steel be best adapted for this purpose? First we have "A," which is a round solid. The same quantity of steel shown in "A," if transformed into shape "B," will be proportionately increased in strength. In the tubular form "C," we have still greater strength, that is, for varying strains. The strength is uniform at every curve of the circle, and not concentrated at particular points. In form "D," we have

B

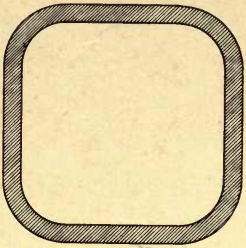
a still stronger formation of a given amount of metal—the hollowed square.



C

Therefore, the hollow square form of spoke provides the greatest strength for motor truck wheels, to resist end and side strains.

All steel or iron castings are composed of crystals which are formed as the metal cools, and run as consistently as the fibres in wood, and as the weak spots in wood are where the branches run out, so are found weak points in castings where they join at *right angles*. Crystals form regularly at right angles with the contour of the casting at all times.



D

In a casting the shape of a right angle as shown in Figure 1, the crystals are formed at right angles from each side of the casting. At AB two crystal formations meet and cause the line of weakness. In Figure 2, the lines of weakness are at CF, ED or CD. The crystals run regularly all the way along the straight sides of casting, but the formation of crystals is

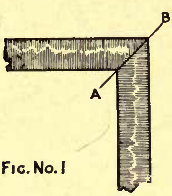


Fig. No. 1

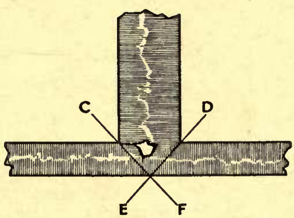


Fig. No. 2

changed on the side where the intersection occurs. To overcome this irregularity at intersections, heavy fillets have been used as in Figure 3, but not with very gratifying results. Though the crystals arrange themselves radially without any break on account of the curve, the added amount of metal of a fillet together with that of lug or arm is apt to result in shrink holes, and the grain or crystals are coarser at that point, CF. These shrink holes, as in Figures 2 and 3, are very irregular in form and size, so it is apparent that fillets are but a doubtful remedy, and serve the purpose poorly. (However, a core might be used to advantage where such shrink holes occur.)

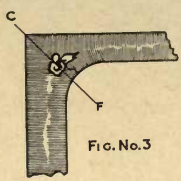


FIG. No. 3

Figure 4 is a combination of Figures 2 and 3 with the added use of the core. Nevertheless, there would still remain weak points at the junctures AB, even though the shrink holes were eliminated.

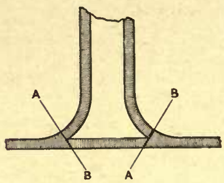


FIG. No. 4

Figure 5 shows the *ideal design* without juncture or joint. The blending of hollow spokes and rim in the wide sweeping curves renders formation of crystals continuous and of uniform strength.

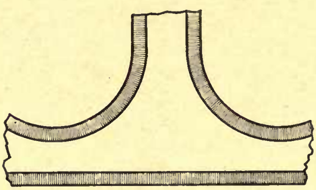


FIG. No. 5

Figure 6, page 31, represents a wheel which will hardly answer the purpose of a truck wheel. The hollow spokes join the rim at almost a right angle, and no effort is made to eliminate the line of weakness as seen at Figure 1, AB. Shocks are transmitted to supporting point; this wheel would break in the spoke near the rim or in the rim near the spoke. In Figure 7, page 31, a hollow spoke joins the hollow rim, but still no effort is made in overcoming the line of weakness at joint of spoke and rim. But the hollow rim partially distributes shocks over a greater portion of the rim rather than just between two spokes. However, the break would still occur at the same place as in Figures 6 and 8, that is section AA and BB.

Figure 11, page 33, represents the Dayton type and is characteristic because of its elimination of weak places, at connections, allowing uniform crystal formation, also because of the narrow arch construction of rim and spoke, permitting uniform vibration and uniform strength throughout wheel rim.

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THE strength of castings does not depend entirely upon the excellency of the mixture, or of the brands of metal employed in the production of the castings, but much also is to be referred to the design of the casting, with respect to its general outlines or conformation, considered with regard to the influence of its form upon the arrangement of the crystals of the metal when it changes from the liquid to the solid state. Crystals of castings arrange themselves with their principal axes perpendicular to the external contour of the casting, and the lines of junction of these groups of planes of crystallization are lines of weakness in the casting. Sudden and great alterations in the thickness of the metal in adjacent parts of the same castings are for similar reasons also highly injurious. Figure 32 shows the arrangement of the crystals in the simplest form of casting—viz., in a square plate, where the diagonal lines of weakness extending across the plate from corner to corner are shown; but the particular crystalline structure developed in the casting depends upon the quality of the metal employed, and the rapidity with which the casting operation is performed.

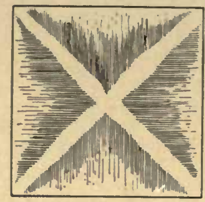


FIG. 32

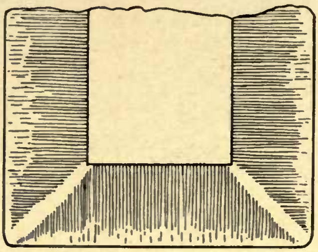


FIG. 33

Sudden or abrupt changes in the form or thickness of a casting are for like reasons to be avoided, since along the line of junction of a thicker and thinner portion of a casting will be a plane of weakness coinciding with the plane towards which the principal axes of crystallization in the two parts are directed;

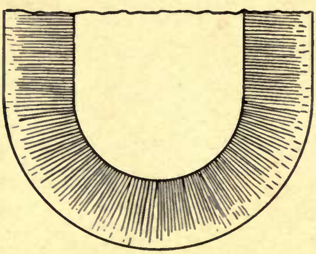


FIG.34

whereas if the change be not abrupt, but pass gradually from the thin to the thick portion, or if instead of a sudden angular change of form the curved form be adopted, then the principal axes of crystallization no longer assume a straight line, but take a curved line, and their destructive tendency is mitigated. Figure 33 shows the weak square angle, and Figure 34 the stronger circular or curved end, as applied to the closed end of a cylinder or other similar casting.

Today the demand is ever for increased speed in the use of motor trucks. Big truck lines are being established between distant cities, as an auxiliary form of transportation to the railroads, because the capacity of the railroads as freight carriers is greatly overtaxed. This in addition to the great increase of local truck service everywhere. As some of the through truck lines are maintaining an average speed of from twenty to thirty-five miles per hour over country roads, it is manifest that the truck wheel must be constructed so as to provide the greatest possible strength combined with resiliency.

In passing over rough roads at high speed, the motor truck wheel is subjected to more terrific punishment than any other part of the truck; it is the buffer to first receive all road shocks and side thrusts caused by skidding. Also in many cases trucks of a rated capacity are greatly overloaded, which adds to the endless number of strains they must endure.

DURABILITY AND ECONOMY

It is very essential that the design of the correct motor truck wheel insures not only that wheel outlasts the truck, but that there shall never be any possibility of the wheel needing repairs. Where repairs are required, as frequently happens on built-up wheels in use, the consequent interruption of motor truck service is not only exasperating, but very expensive in loss of time and money.

As clearly shown on preceding pages, when the correct motor truck wheel is provided that embodies proper resiliency and strength, it makes for the greatest durability, not only of wheel, but also will greatly lengthen the life of the truck itself, by preventing excessive road shocks from reaching the axles, bearings and motor, the heavy vibrations being dissipated in the wheel.

LIGHTNESS

In wheel engineering it is an established fact that one pound of dead weight in the wheel is equal to ten pounds of paying load above the springs. Therefore, it is very important that the correct motor truck wheel be made as light in weight as possible, with proper disposition of metal so as not to detract from maximum strength.

Lightness will also effect a considerable saving in gasoline consumption—will increase the speed of the truck—as well as decrease the cost of the wheel by the use of less metal.

SECTION THREE

HOW THE MOTOR TRUCK WHEEL PROBLEM IS *SUCCESSFULLY* SOLVED IN DAYTON CAST STEEL WHEELS

DETAILS OF CONSTRUCTION

WHEN the inventor started several years ago to solve the motor truck wheel problem, he was confronted by one of the most stupendous tasks ever attempted by an engineer or inventor. There were already in existence such types of steel wheels as shown in Figures 6, 7, 8, 9 and 10 on succeeding pages. But all were lacking in two or more of the essential qualifications. The vital problem still remained to provide a steel wheel that would successfully receive and dissipate excessive shocks due to motor truck passing over rough roads at good speed.

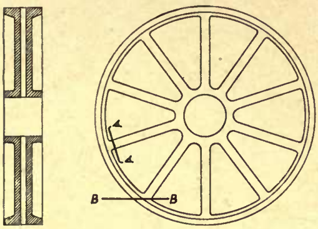


FIG. 6

In 1905 he established a foundry where crucible steel castings were produced. Year after year he applied his technical knowledge to the making of improved steel castings. It was only

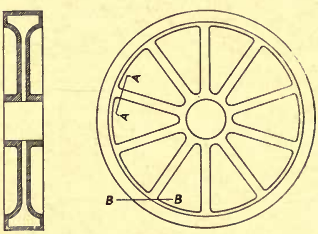


FIG. 7

by the closest application and display of great patience that progress was made in foundry practice step by step, which finally resulted in the wonderful quality of high-grade steel castings produced today at the plant of The Dayton Steel Foundry Company.

DESIGN

Dayton Steel Wheels are cast in one integral member from electric furnace steel, the hub, spokes and rim being integrally united. The hollow spokes extend in broad, sweeping curves and form the rim, which is hollow opposite the spokes to the points where the curvatures of the spokes form the rim. There are no parts to work loose or get out of order. The walls of the hollow spokes and rim are of uniform thickness.

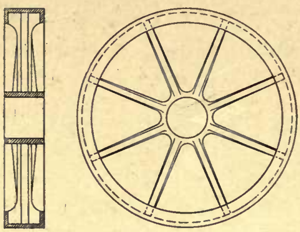


FIG. 8

A striking feature of the design is the use of an uneven number of spokes which prevent shocks from passing directly through hub diameter. Another feature of construction in the Dayton Steel Wheel is the broad sweeping curves which branch in *all directions* from the spokes to form

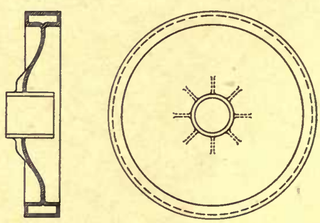


FIG. 9

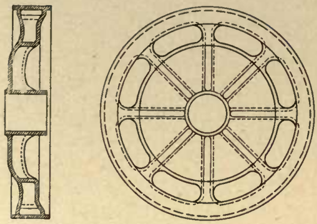


FIG. 10

the rim, so there is no dangerous overhang to the rim. Thus the arch principle of construction prevails throughout. In wood wheels of larger sizes, there is considerable overhang of the outer part of the rim, and when truck is passing over rough surfaces, the greater part of the load must be sustained on the outer edge of rim, not directly supported by the spokes, which of course, exerts a great leverage on the outer part of the rim.

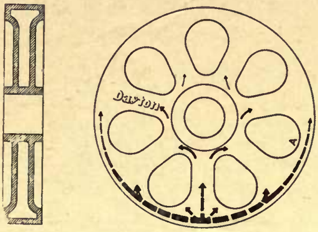


FIG. 11

Seeing that the whole load is taken on two or three spokes, when the truck is skidding sideways, one can better appreciate the economic disposal of metal in Dayton Steel Wheels, to react on these tremendous side strains.

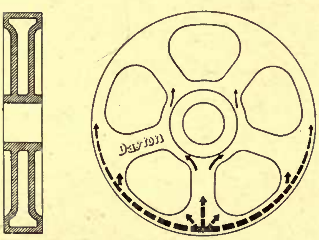
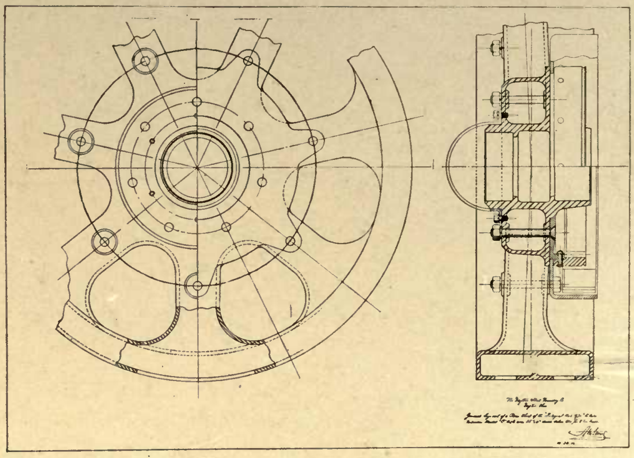
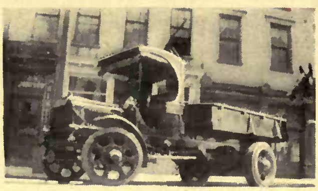


FIG. 12

This form of steel wheel casting is a triumph of modern day scientific foundry practice, for which Letters Patent were granted to George Walther, December 8th, 1914.

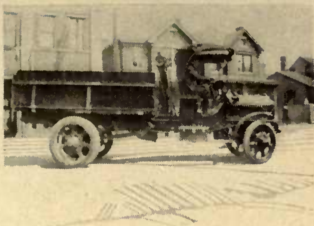


RESILIENT OR ELASTIC



The design and construction of Dayton Steel Wheels makes for the required resiliency, which is the most vital quality necessary in a motor truck wheel today.

Only after years of careful study and tests, was the perfected wheel produced. The desired elastic limit of the steel was finally obtained after much experimenting in laboratory, and with wheels in actual use.



While many Dayton Steel Wheels have been in service as long as six years, there is not a single case on record where a Dayton Wheel developed a crack.

The construction of the rim section is very important, it very readily assists in dissipation of shocks. The shock energy is dissipated like vibrations at the end of a tuning fork. However, the Dayton Steel Wheel is perfectly balanced and shocks are not taken up in the rim only, but are distributed over the entire wheel, because there is no stoppage to the course of vibration.

The scientific design of the Dayton Steel Wheel, made of the highest grade electric furnace steel, arranges the crystals in perfect order in the hollow spokes, which blend with and form the hollow rim in wide, sweeping curves. This renders the arrangement of crystals continuous and of uniform maximum strength.

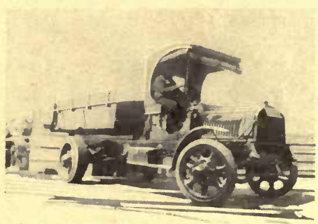
In this manner is the great problem of resiliency or elasticity solved by Dayton Steel Wheels.

ANNEALING — All Dayton Steel Wheels are carefully annealed after being cast. This is done by placing the wheels in furnaces where a uniform

temperature is maintained of the proper duration and at the proper degree. The temperature is indicated by thermo-couples placed in each furnace with recording dials in the chemical laboratory. After the proper heat treatment, the wheels are allowed to cool slowly, which has the effect of softening the metal a little, refining and uniting the grains more closely. By the process of slow cooling the crystals are arranged in perfectly uniform order, which makes for maximum strength and elastic limit.

ELECTRIC FURNACE STEEL—With the development of the steel industry, especially of late years, the electric furnace is being used more and more to produce steel castings of high grade for special uses.

Of all the steel furnaces, the electric furnace is the most susceptible of accurate control. With the heat applied in the cleanest way possible, i. e., without the admission of coal ash, or gas or air of the blast, the atmosphere in the tightly-closed electric furnace can be made "oxidizing," "neutral" or "reducing," at will. The metal can be held in the furnace and additions made, samples taken, and the operations conducted with



regulation and certainty. Under proper conditions, the elimination of phosphorus and sulphur from the metallic charge in electric furnace is far more complete than in the open hearth or any other process of steel manufacture.

The Dayton Steel Foundry is equipped with electric furnaces of the most approved type, where is produced the highest grade of steel possible for motor truck wheels. Careful laboratory tests are made of each charge of metal, which, combined with the proper heat treatment, brings the metal into a state where the crystals are small, the elastic limit is high and the metal is well adapted to endure shocks which would otherwise cause fatigue.

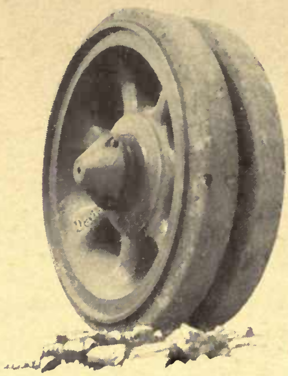
OF MAXIMUM STRENGTH

The great strength of Dayton Steel Wheels, due to unique design and use of the strongest metal known, is a triumph of modern day engineering skill.

The adaptation of the hollow square form of spokes as shown in figures "D" and No. 5 on pages 23 and 24 makes for the greatest strength in the disposition of a given amount of metal.

SCIENTIFICALLY CORRECT

Results have proven that the Dayton Steel Wheel is scientifically correct. Recent tests of this wheel by the Bureau of Standards at Washington, D. C., developed some wonderful results.



Tests were made of various kinds and types of wheels of cast steel, malleable, built-up and wood, for the purpose of establishing definite data for guidance in designing the most efficient wheel for the hardest service. Strength, weight and service only were considered as important factors.

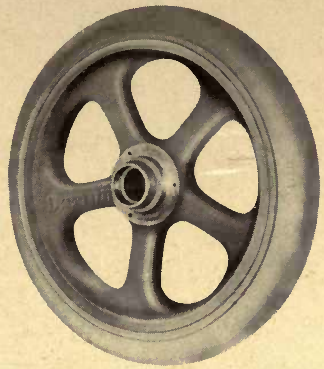
A Dayton Steel Wheel (rear) 36 x 10, on side thrust testing apparatus, broke at 101,000 pounds, making it necessary to remove the load. The permanent set or deflection of radial compression of 100,000 pounds was .0114 inches.

UNDER SIDE THRUST TEST

The Malleable Iron Wheel showed 40% less than Dayton Wheel.

The Disc Type Wheel showed 18% less than Dayton Wheel.

The Cruciform Solid Spoke Wheel showed 30% less than Dayton Wheel.



Dayton Steel Wheels are so constructed as to incorporate the vital factor of "human safety" to a high degree. Due allowance has been made for a wide margin of all contingencies, such as extraordinary blows or shocks, heavy overloading of the truck of rated capacity, and all other forms of abuse which might possibly occur, and still not approach the limit of elasticity and strength.

The symmetrical appearance of Dayton Steel Wheels adds the final look of efficiency to the trucks—they suggest strength.

DURABLE AND ECONOMICAL

It naturally follows that as Dayton Steel Wheels are constructed with greatest resiliency and strength they at once become the most durable and economical type of motor truck wheel.

Dayton Steel Wheels will not only last much longer than other types of motor truck wheels in service, but by reason of their resiliency and strength, will prolong the life of the truck on which they are placed.

Investigation shows that in hard service it is usually necessary to replace wood wheels one or more times during life of truck, and in addition, certain repair work is necessary with consequent expense and loss of time. In cases like this, truck owners, especially fleet owners, can use Dayton Steel Wheels for replacement, to great advantage.

Dayton Steel Wheels are so constructed as to not only provide greatest resiliency, strength and durability, but also that which is of great importance—minimum weight.

The disposition of metal is so arranged that there is not a pound of superfluous weight, for extra weight of that sort would mean greater motive power, a larger consumption of gasoline, a decrease of speed, and also add to the cost of the wheel itself.

At recent tests by the Bureau of Standards at Washington, D. C., of various types of motor truck wheels it developed:

That the complete hubless type wheel, malleable or steel, is from 10% to 15% heavier than the integral hub Dayton Steel Wheel, because of the added weight of hub, flange and bolts. That the disc type

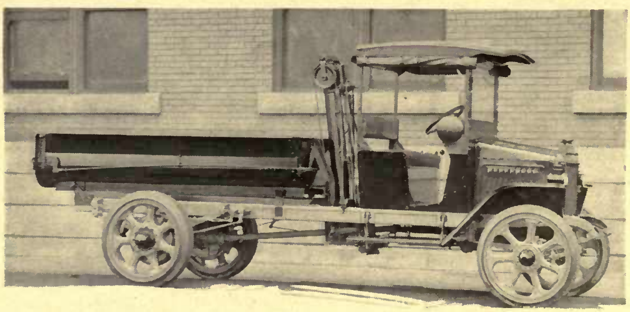
and the cruciform solid spoke type showed from 10% to 30% heavier than the seven hollow spoke, hollow rim Dayton Steel Wheel.

The wood wheels of the better grades with hub, flange and bolts in the two-ton sizes, weigh substantially the same as Dayton Steel Wheels, but in sizes over two-ton capacity, the wood wheels weighed more, in some cases 100 pounds more per set.

In maintaining minimum weight of the Dayton Steel Wheels, however, much care has been exercised not to detract from its efficiency by impairing the strength in any way.

LENGTHENS LIFE OF TIRES

There are many cases on record which prove that steel wheels give greater tire mileage than wood wheels. The Cincinnati and Suburban Bell Telephone Company keep an accurate card record of the mileage given by every tire used on their fleet of



trucks. Two front tires on one of their three-ton trucks equipped with steel wheels gave an average of 7,500 miles, while two rear tires on the same truck gave an average of 9,485 miles. Five front tires on one of their two-ton trucks, equipped with wood wheels, gave an average of only 5,740 miles, while eight rear tires on the same truck gave an average of only 4,508 miles.

Dayton Steel Wheels also tend to keep the tires cool, as they conduct the heat caused by road friction and internal friction in the tire rubber away from the tires. Wood is a non-conductor of heat. The tires can not come off, nor creep on the wheel in service, if properly applied; even "curb scraping" will not injure the wheel or affect the tires.

CLIMATIC CONDITIONS

Climatic conditions have no effect on Dayton Steel Wheels. They remain absolutely true in circumference under all conditions. They can not shrink in dry weather nor swell in wet weather. On the contrary, wood wheels are always affected by climatic conditions which, combined with severe stresses, tend to loosen the spokes at hub and rim, causing "flats" and consequent pounding of bearings, axles and tires.

It is quite evident that the use of steel wheels on all motor trucks in the near future is a certainty. Several motor truck manufacturers have already adopted steel wheels as standard equipment and give them their hearty endorsement. The many superior advantages and special patented features of the Dayton Steel Wheel, as compared with all other types of wheel, either wood or metal, establishes their claim of supremacy, already fully proven by every form of test.

SECTION FOUR

INDORSEMENTS OF DAYTON STEEL WHEELS

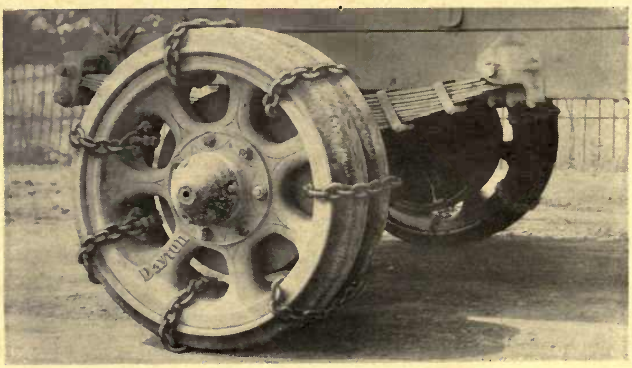
ARTICLE BY GEO. C. WRIGHT, M.E.

GEO. C. WRIGHT

PROBABLY more than any other thing, the severe tests of army service both in Mexico and France, have resulted in the special and careful design of wheels to meet the needs of that service on heavy trucks, trailers, tractors and ordnance. *Excessive* resiliency or springiness is not required, but strength to withstand any possible overload or side thrust; such constructions as will not fail under repeated shock or vibration; that will be reasonably cheap to construct and require very little cost or effort for maintenance.

Generally speaking, wheels of the built-up type, whether disc, artillery, spring spoke or cushioned, fail in two or more of the above mentioned characteristics. They may loosen at hub or rim, causing bolts to shear; collapse due to side thrust, if vehicle skids or drops in a rut; become loose and out of true, requiring a considerable maintenance cost; fail due to overloading and at the same time be very expensive to build due to multiplicity of parts. Likewise cast steel wheels improperly designed and manufactured may be very unsatisfactory. Cast with insufficient fillets in the corners between the spokes and hub or rim, weak points are very liable to occur. Cast with solid spokes and rim, the weight will be much out of proportion to strength and in strengthening solid spokes, webs are very often used which make for unsightliness.

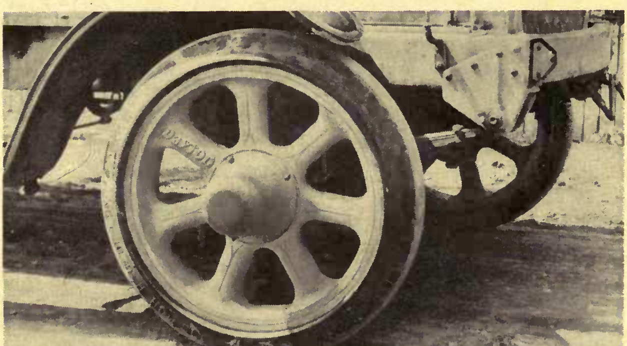
Investigation of the design of the Dayton Steel Wheel and of the manufacturing methods of The Dayton Steel Foundry Company proves conclusively that all of the common defects of other wheels have been overcome. The spokes and rim are cored hollow, leaving walls of very uniform thickness. The hub, spokes and rim are joined by large arches, which not only remove the possibility of disruption of crystals due to sharp corners, but also act very effectively to dissipate shocks received at any point on the rim before they can be transmitted to the hub or axle.



The spokes, being of wide section parallel with the axle and joined to the rim and hub by arches previously mentioned, insures the ability of this wheel to endure most severe side thrusts, a fact borne out by Government tests. Cast in one piece, there are no joints to become loose, hence no maintenance cost. Furthermore, the rim being machined perfectly true with the hub, tires are easily applied and there is no possibility of wheels becoming eccentric and thus injuring the vehicle due to pounding.

Correct design alone would be of no benefit if the foundry methods were poor. Using a high grade of electric furnace steel carefully moulded to give uniform section throughout and finally annealed according to latest practice is a guarantee of long life. The cost, weight, strength, and artistic design of this wheel should appeal to any manufacturer of trucks.

GEO. C. WRIGHT, M. E.
Instructor of U. S. Motor Transport School of Michigan Agricultural College.
Member of S. A. E., formerly in charge of experimental tests of Cadillac Motor Car plant.



ARTICLE BY E. C. SHUMARD, M. E.

DURING the past few years I have been very much interested in the proposition of motor truck wheels and have investigated various makes of steel wheels in comparison with wood wheels for trucks for heavy duty.

After thorough investigation and tests I am convinced that the Dayton Cast Steel Wheel is the best wheel that has come under my observation. The principal reasons for my conclusion in this matter are the arch construction of spokes and rim, and especially the use of an odd number of spokes which serve to distribute the load and road shocks throughout the wheel.

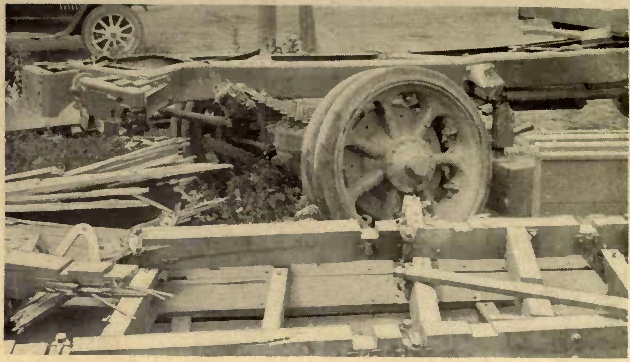
My experience with wood truck wheels shows that, on heavy duty trucks, it is generally necessary to replace the wheels one or more times during the life of the truck.

The chief reason for the failure of the wood wheels in service being that, under hard conditions, the spokes loosen at the hub and felloe, and once they become loosened, it is only a matter of a short time until it is necessary to replace the wheel. I find that it is impossible to have a wood wheel repaired so as to stand continuous hard service.

In regard to the matter of price, I believe any truck maker should be willing to pay a little more for Dayton Steel Wheels than for any other, because as stated above, they seem to me to be superior.

I find that among owners of large fleets of heavy duty trucks, there is beginning to be a very noticeable demand for steel wheels. I attribute this to the fact that the owner of a large fleet of trucks is generally on the lookout for improvements, while the average owner of a few trucks does not pay much attention to this matter.

E. C. SHUMARD,
Member S. A. E.



STEEL WHEELS UNINJURED WHEN TRUCK IS WRECKED BY FAST TRAIN

While attempting to turn a 3-ton Liberty truck equipped with steel wheels at the plant of The Dayton Steel Foundry Co., Dayton, Ohio, on June 13th, 1918, the driver backed the truck onto the B. & O. Railroad tracks.

He failed to see an approaching passenger train which hit the truck opposite the rear axle. The truck was demolished, the rear tires, which were applied under a pressure of 90 tons, were found partly off. The steel wheels with which the truck was loaded were scattered around over a radius of 100 feet. The body of the truck was reduced to kindling wood and the truck turned completely around and thrown some 30 or 40 feet.

The frame was badly twisted and bent heavy alloy steel springs and other parts were broken, but the steel wheels on truck were uninjured.

It is their ability to withstand such shocks as this which caused all of the Allied armies to adopt steel wheels for trucks and artillery in the war zone.

Tire economy is carried to its utmost limit by the use of large diameter wheels made of special steel, which are indestructible; combined with a proper load distribution in regard to the front and rear axles. Steel wheels remain absolutely true in circumference, and of unvarying diameter, no matter what the weather conditions. Consequently the solid tires are not subjected to the ruinous contraction and expansion which takes place in wood wheels during extremes of weather. Steel wheels also act as conductors of heat, which prevents the tires from becoming overheated, a condition which rapidly deteriorates them, and which is extremely noticeable where solid tires are applied to wood wheels.

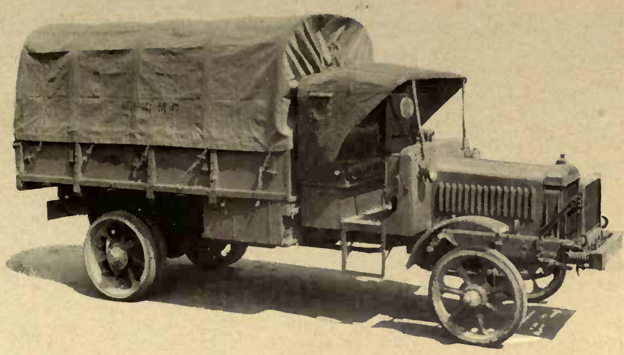
—From the Catalog of a large Motor Truck Co.

METAL TRUCK WHEELS POPULAR IN EUROPE

REPORTS from Europe indicate that wood has been eliminated from motor truck wheel construction in about 90 per cent of European motor vehicles on account of war conditions. It does not always follow that a design or type of construction which has proved superior under war conditions will be the best for peace conditions, but in *this case* it seems that the types of wheel which have proved superior in war undoubtedly will be retained after the war.

For heavy loads above 2 tons, the cast steel wheel is the only type used by European makers. There are practically no trucks of 3, 4 or 5-ton capacity now built in England, France or Italy with wood wheels.

The Fiat Company, which is not only the largest motor concern in Italy, but the biggest producer in Europe, decided on metal wheels as far back as 1903, and has adopted cast steel to the exclusion of wood; that company has never built a commercial vehicle with wood wheels.—*Commercial Vehicle.*



CAST STEEL WHEELS STANDARD ON LIBERTY TRUCKS

WHEN the U. S. Government Board of Engineers designed the Liberty Motor Truck, all the different types of truck wheels were carefully analyzed, and after most severe tests, a type of wheel was adopted, called the composite wheel, embodying many of the features of the regular Dayton Cast Steel Wheel.

The composite wheel is made of high-grade cast steel with hollow spokes and rim, the spokes extending in wide sweeping curves to form the rim. This type of wheel is standard on Class B motor trucks, and used in as great quantities as possible to produce.

This is another endorsement of the design and construction of Dayton Steel Wheels.

On this page we reproduce a photograph of a Class B Liberty Motor Truck equipped with composite cast steel wheels.

WHERE DAYTON STEEL WHEELS ARE MADE

AT the plant of The Dayton Steel Foundry Company, Dayton, Ohio, where are produced Dayton Steel Wheels, there is presented a striking instance of unexampled activity, and the way in which the customary process involving greatly increased production has been revolutionized. Here an existing plant with a commodity urgently needed, has carried on production coincident with rapid plant extension.

Manufacturing problems of a pioneer character have been complicated by industrial growing pains. This company has met the situation by applying the most modern of foundry operations and by adapting its facilities to new conditions.

Shop methods were altered to secure quantity production, new buildings erected and many acres of space added. Many expensive machines were installed so as to accurately machine the hubs and rims of the wheels as fast as they are produced in the foundry.

From start to finish, the most modern and scientific methods are employed. Nothing is left to guesswork—the utmost precision prevails in every detail of manufacture. A complete physical and chemical laboratory is maintained. The physical laboratory has band saws for cutting coupons, lathes for turning test bars, and drill presses which are used to take drillings for the chemical laboratory. Chemists carefully check all heats taken in the electric furnaces during the 24-hour operation of the melting units.

The temperature of the annealing furnaces is indicated by thermo-couples placed in each furnace with recording dials in the chemical laboratory, and the anneal is carefully governed according to the chemical analysis of the casts.

Illustrations show a section of the main moulding floor with top of a 3-ton electric furnace removed for relining, also a general view of the machine shop and laboratory.