(No Model.)

3 Sheets—Sheet 1.

F. E. CANDA.

CAR WHEEL.

No. 605,391. Patented June 7, 1898.

Fig. 1,

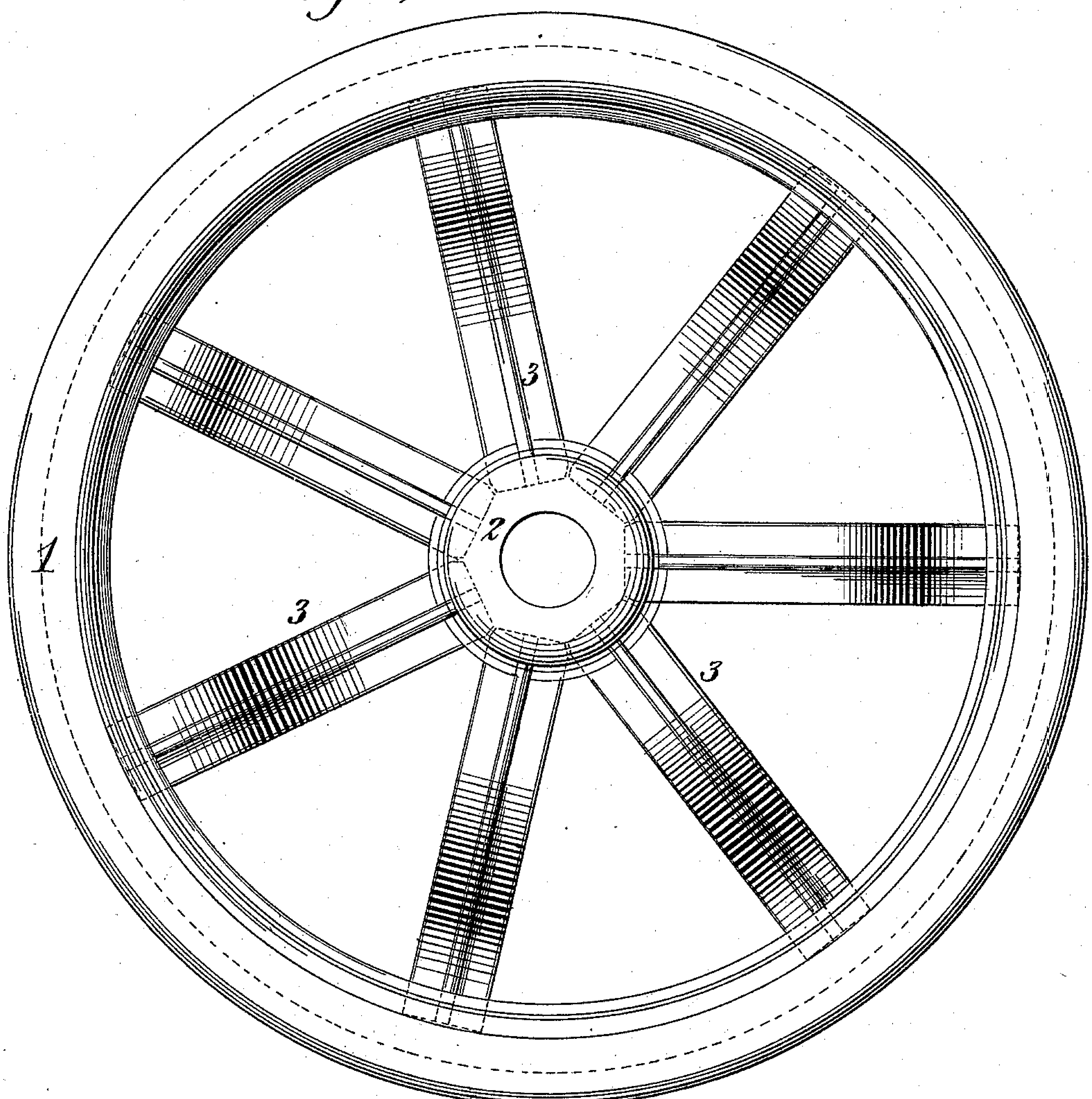
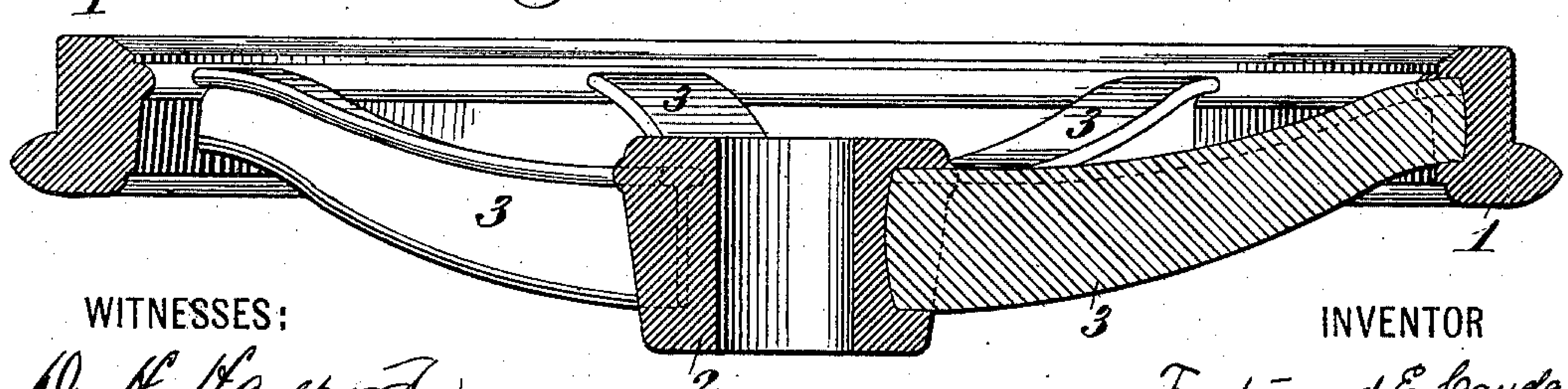


Fig. 2,



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(No Model.)

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Fig. 3,

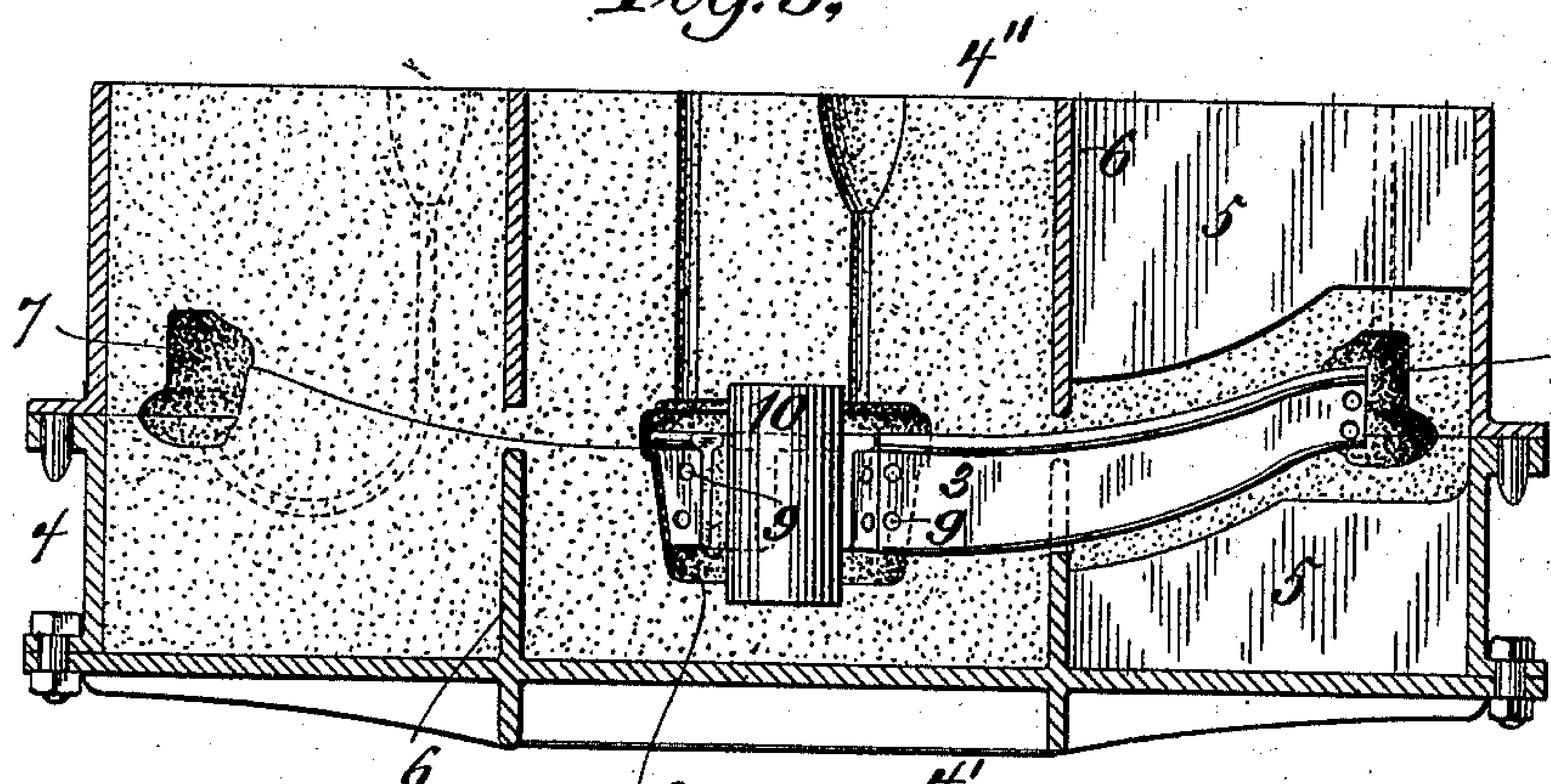

Fig. 4,

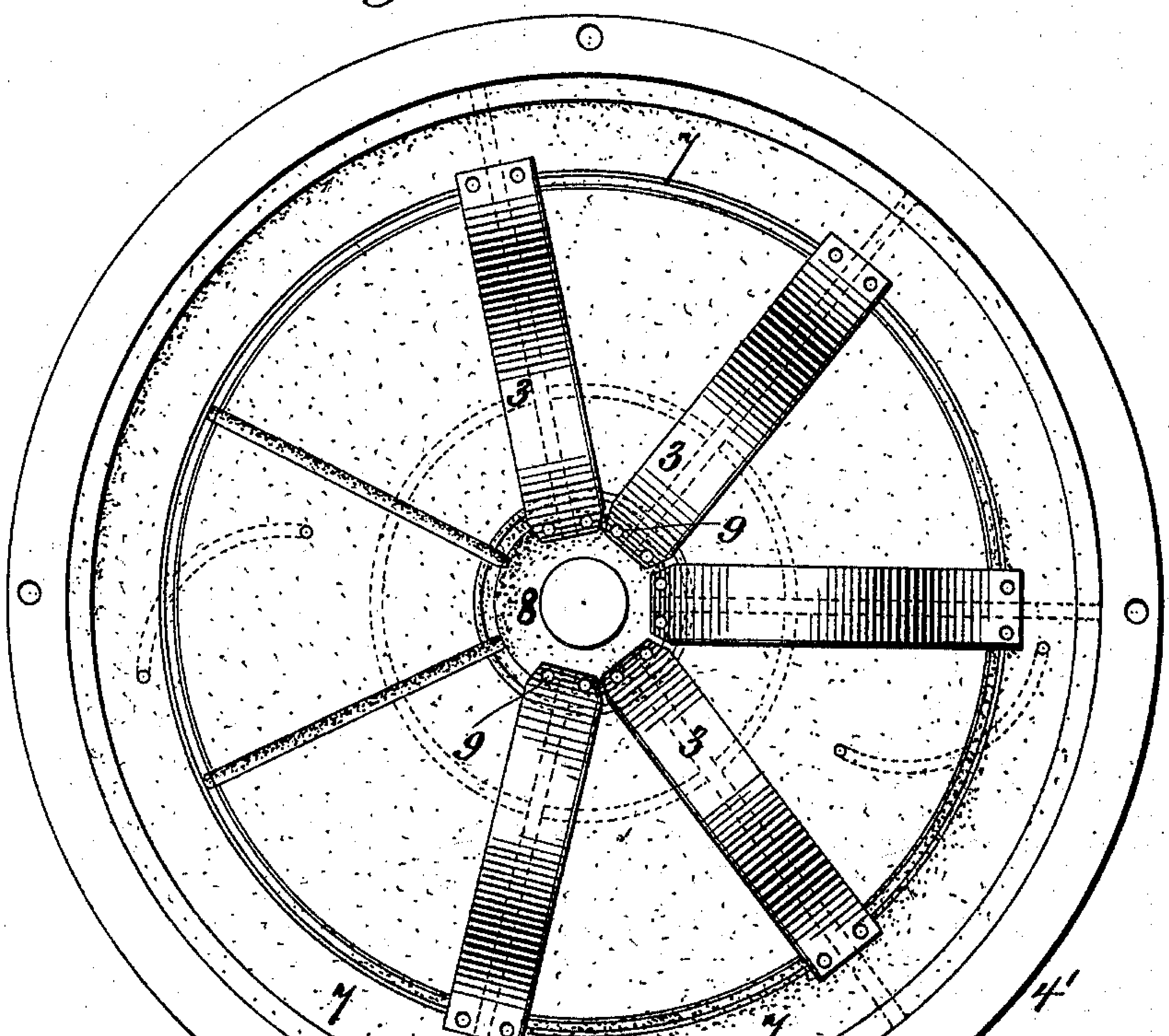

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Fig. 5,

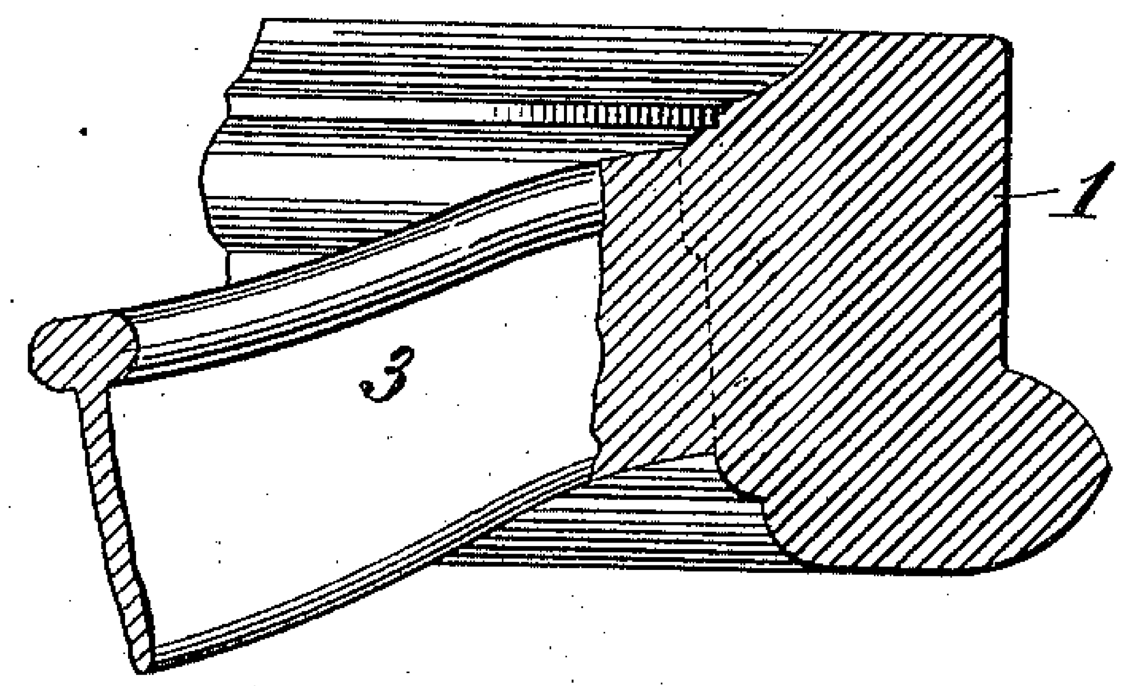


Fig. 6,

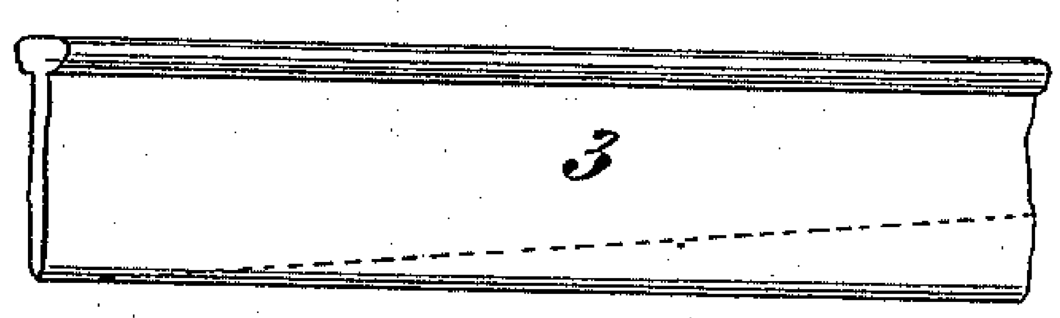


Fig. 7,

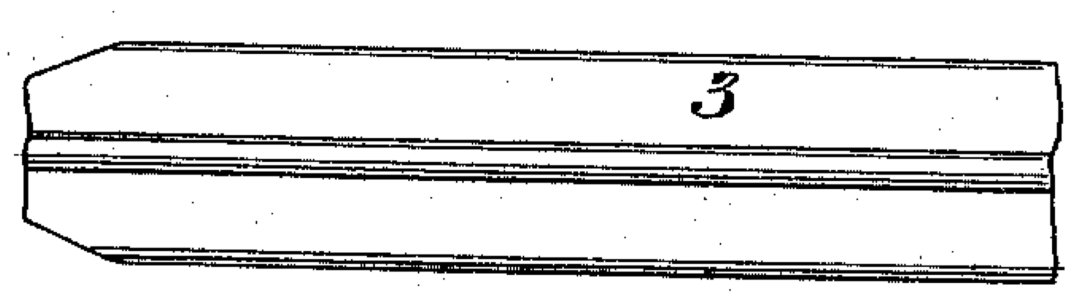
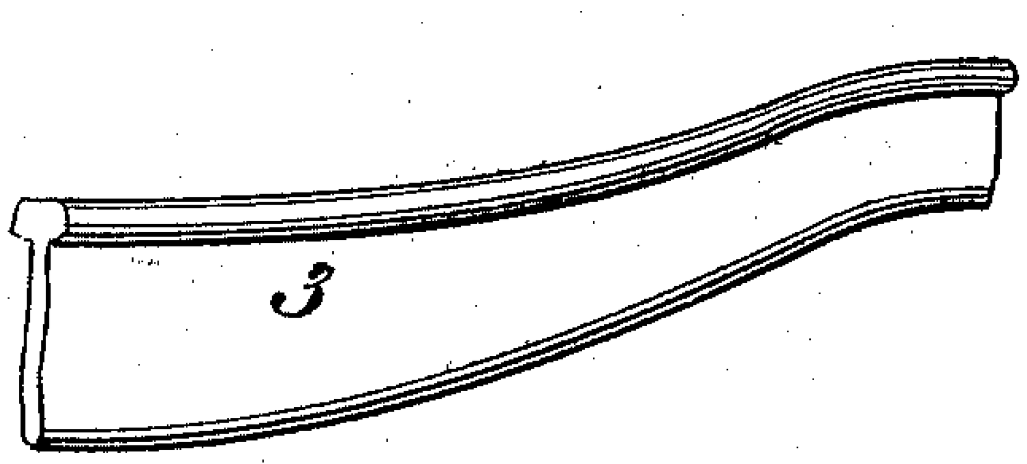


Fig. 8,



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UNITED STATES PATENT OFFICE.

FERDINAND E. CANDA, OF NEW YORK, N. Y.

CAR-WHEEL.

SPECIFICATION forming part of Letters Patent No. 605,391, dated June 7, 1898.

Original application filed September 11, 1896, Serial No. 605,486. Divided and this application filed September 27, 1897. Serial No. 653,146. (No model.)

To all whom it may concern:

Be it known that I, FERDINAND E. CANDA, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a new and useful Car-Wheel; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to car-wheels; and it consists in a wheel made wholly of steel or wrought iron and steel, the parts of which have been welded together, so as to constitute one integral mass of metal.

My invention consists in the novel construction of the wheel.

The object of my invention is to provide a car-wheel which shall be integral, free from internal stresses, and lighter, stronger, and cheaper of manufacture than any known high-grade wheel. This object is attained in the wheel herein described, and illustrated in the drawings which accompany and form a part of this specification, in which the same reference-numerals indicate the same or corresponding parts, and in which—

Figure 1 is an elevation of a car-wheel embodying my invention and made in accordance with the hereinafter-described process. Fig. 2 is a diametral section of the wheel. Fig. 3 is a diametral section of the mold-flask and completed mold with the hub-core and spokes therein. Fig. 4 is a plan view of the drag and mold therein, the cope having been lifted off, thus leaving the mold open. Fig. 5 is a detail section of a portion of the rim and one spoke, in which the weld between the rim and spoke is illustrated. Fig. 6 is an elevation of one of the blanks from which the spokes are formed. Fig. 7 is a plan view of a completed spoke, and Fig. 8 is a side elevation of the completed spoke.

Car-wheels carry heavy loads, are subjected to sudden and very severe shocks at rail-joints and other similar places, and are likewise subjected to severe stresses at curves and when the brakes are applied. These considerations and the serious consequences that are likely to attend the breaking of a car-wheel while the car is moving make it desirable that car-wheels shall be very strong and capable of withstanding severe shocks and stresses and that they shall be composed of some strong tough metal or other suitable material, the strength of which and of the wheel made from it may be accurately known and which is not readily cracked or broken. The type of car-wheel most generally used is the cast-iron wheel. Cast-iron, as is well known, is not a strong and tough metal, but, on the contrary, is weak, brittle, and particularly when cast in bodies of irregular section, such as car-wheels, is subject to shrinkage stresses of considerable but unknown amount, which weaken the resulting article and render it liable to crack while in use. These objections to which cast-iron car-wheels are subject have in many cases led to the use of built-up car-wheels, such as the well-known paper car-wheels; but the necessarily greater cost of wheels made by any process other than that of casting has prevented the use of built-up car-wheels for most purposes.

Attempts to use a better material than cast-iron, such as cast-steel containing a low percentage of carbon, have also been unsuccessful in the past for the making of car-wheels of standard size, at least. This is due to the fact that although cast-steel car-wheels if free from excessive shrinkage stresses and other internal stresses would possess the necessary toughness and strength the higher temperature at which the metal solidifies (a temperature very much higher than that at which cast-iron solidifies) causes excessive shrinkage after the metal has set in articles of the size and irregular section of car-wheels, producing excessive shrinkage stresses, which make the resulting wheel brittle and render it liable to crack or break.

Attempts have also been made to produce cast-iron car-wheels of greater strength than wheels cast in one piece by casting the hub and rim separately and connecting the hub and rim by wrought-iron spokes placed in the mold before the molten metal is poured into the mold, so that the molten metal surrounds the ends of the spokes and in cooling grasps the spokes. Such wheels, however, have not proved superior to wheels cast in one piece. The molten metal about the ends of the spokes is chilled and solidifies more rapidly than the rest of the metal, thus causing lack of homogeneity and the setting up of internal stresses in the hub and rim. Moreover, there is no union between the metal of the spokes and the metal cast about them, since the temperature at which cast-iron is poured is too low to raise the ends of the spokes to a welding heat, and as a result the spokes are merely held mechanically, so that crumbling of the metal about the spokes causes the spokes to work loose.

Car-wheels are also made by forming from mild steel a rim and while the rim is heated to a very high degree placing it in a mold and casting into the rim a cast-iron hub and a connecting-web. It is claimed that by this method of construction a weld is produced between the steel rim and the hub and web cast within it; but the resulting wheel is not altogether free from shrinkage and other internal stresses and possesses the disadvantage of being composed to some extent, at least, of cast-iron.

The wheel which forms the subject-matter of my invention consists of a cast-steel hub and rim united by wrought-iron or mild steel spokes which are welded into the hub and rim, so as to make the wheel one integral piece of metal.

In making the wheel a mold is made for the wheel as if the wheel were to be cast entire, separate gates, risers, and vents, however, being provided for the hub and for the rim. Spokes are formed from structural or mild steel by cutting beams of this material, preferably of T-section, into proper lengths, cutting the webs of the blanks so formed to give the spokes the proper taper and bending the spokes to offset the hub from the rim the proper amount, as hereinafter described. The spokes so formed are placed within the mold in the recesses formed by the spokes of the pattern, their ends projecting into the hub and rim molds. The rim and hub are poured separately, the rim being poured first, and after the metal of the rim has set and most of the shrinkage toward the center of the wheel has taken place the hub is poured. The molten metal must be poured at a temperature enough higher than that actually required to permit the metal to fill the mold to overcome the tendency of the spokes to chill the metal about their ends and to raise the ends of the spokes to a welding heat before full solidification of the molten metal about the spokes has taken place. The heat, together with the great pressure caused by the contraction of the metal about the ends of the spokes, welds the spokes into the hub and rim, so as to become integral therewith. The wheel is then allowed to cool and is afterward annealed at a cherry-red heat to remove internal stresses and to restore to its original condition the metal of the spokes, which by the heat of the molten metal is rendered brittle.

Referring now to the drawings and first to the parts of the wheel itself, 1 is the rim of the wheel, and 2 the hub.

3 3 are the spokes, formed of what is known as "mild" steel, in contrast with hard or tool steel, and corresponding in most of its properties to wrought-iron, though more homogeneous and of greater strength. Wrought-iron may be used for the spokes instead of mild steel, however, if desired, and since both metals possess in substance the same qualities and in particular the quality of welding they may be termed, generically, "welding" metal. The spokes are preferably of some section having a web and flange at right angles, preferably a T-section.

4 is the flask containing the mold within which the wheel is cast. It is a two-part flask, such as is ordinarily used in casting car-wheels, 4′ being the drag and 4″ the cope. The cope and drag have radial partitions 5 5 and also have rings 6 6 substantially concentric with the mold when formed, the purpose of which is to prevent the destruction of the hub-mold by the movement of the sand in the flask during the contraction of the rim. The rings 6 6 prevent the movement of the sand near the hub-mold and therefore prevent the destruction of the hub-mold.

The mold for the wheel is formed as if the wheel were to be cast complete, a full pattern, having rim, hub, and spokes, being used. Separate gates, risers, and vents are provided for the hub-mold and for the rim-mold, however, as the hub and rim are poured separately. The complete molds are shown in Figs. 3 and 4, 7 being the mold for the rim and 8 the mold for the hub.

The rim-mold is usually provided with two gates, arranged to cause the metal to flow into the mold from the bottom, as shown in Figs. 3, and in a tangential or nearly tangential direction, as shown in Fig. 4, so that when the metal has entered the mold it will fill it rapidly and uniformly and will not solidify at the mouth of the gate prematurely. A number of risers arranged at intervals about the rim-mold are also provided.

The hub-mold is provided with a single gate, and it is usually permissible to have the metal enter the mold at the top. A single riser is all that is usually required.

The spokes are constructed as follows: The blanks for the spokes are formed by cutting into proper lengths beams of mild structural steel having the desired section, which may be one of the standard sections in which such beams are rolled. The web of each blank is then sheared, as indicated by the dotted line in Fig. 6, to give the spoke the proper taper. The spoke is then bent in dies into the shape required to offset the hub from the rim the proper amount.

The method of casting is as follows: A core 10 for forming the axle-hole in the hub is placed within the hub-mold. The spokes 3 3, the ends of which have been protected by glazing them over with a suitable flux, such as that made by borax or boracic acid, are placed within the recesses formed for them in the mold, their ends projecting into the hub and rim molds in the manner shown in Figs. 3 and 4. The cope is then put in place and the mold is ready for pouring. The rim-mold is poured first, so as to allow the rim to contract toward the center without setting up shrinkage stresses, and after the rim has set and most of its shrinkage toward the center has taken place the hub-mold is poured. Usually the hub is poured about ten minutes after the rim is poured. During the contraction of the rim the rings 6 6 of the cope and drag protect the hub-mold from being crushed in or shattered by the movement of the sand inside the rim. The metal for the hub and rim is poured at a temperature so high that before it has completely solidified about the ends of the spokes it has raised the ends of the spokes to a welding heat. Because of the high temperature both of the metal in the hub and rim molds and of the ends of the spokes and because of the pressure caused by the contraction of the metal about the ends of the spokes the spokes are welded into the hub and rim, becoming, in fact, integral therewith, so that when completed the wheel is in one piece of metal throughout. This I have demonstrated by sectioning a wheel so made at the point of union of the spoke and rim. By etching the metal surface at this point I have found that the etched surface shows the blending of the metals between the metal of the spoke and the metal of the rim, which is characteristic of a true weld, without the sharp dividing-line, somewhat similar to a fine crack, which would be observed were the union between the spoke and rim merely a mechanical union.

If desired, the ends of the spokes may be provided with locking-holes 9, such as are shown in Figs. 3 and 4, into which the molten metal of the hub and rim will flow, welding to the sides of these holes and also holding the spoke in place mechanically, as well as by the weld; but I do not limit myself to the use of these locking-holes, and for this reason I have not illustrated them in Fig. 2 or in Figs. 6, 7, and 8.

In the sectional view of the wheel, Fig. 2, in order to show the composite construction of the wheel, I have shown sharp dividing-lines separating the metal of the spokes from that of the rim and hub. As already stated, however, there is no such sharp dividing-line, and the appearance of the surfaces when sectioned and etched is more truthfully represented in Fig. 5, the only thing to distinguish the cast metal from the metal of the spoke being the slightly different color of the cast metal.

The heat of the molten metal makes the spokes brittle. To restore them to their former tough condition, as well as to remove internal stresses that may exist within the rim and hub, the wheel, after it is cold, is next annealed. It is first necessary to permit the wheel to become cold. When cold, the entire wheel is heated in a suitable annealing-furnace to a cherry red and allowed to cool very slowly, as in ordinary annealing operations. After annealing, the metal of the spokes has practically the same properties as before the casting, and the metal of the rim and hub is tough and strong and has all the properties of the best cast-steel. Too low heating during annealing will not produce this result, and too high heating will injuriously affect the properties of the metal.

As shown in the drawings, the spokes do not project entirely through the rim to the outer surface or tread thereof, but project only part way through the rim. This is necessary in order that there shall be no soft spots in the wearing-surface of the rim. The metal of the rim is naturally somewhat harder than the metal of the spokes, and did the ends of the spokes project through to the tread flat spots would soon form at the ends of the spokes, which would make it necessary to throw the wheel aside.

I am aware that it has been proposed to make car-wheels by casting rims and hubs upon spokes previously prepared and placed in the mold; but the object of my invention is not simply to cast steel hubs and rims upon spokes, but is to weld the spokes, rim, and hub together, so that the resulting wheel shall be integral, and, as has been already stated, this can only be done when the molten metal is poured at a temperature enough higher than that actually required to maintain fluidity until the mold is full to heat the spokes to a welding heat and overcome the tendency of the spokes to chill the metal about their ends. I believe the welding of the spokes into the rim and hub by the heat of the molten metal and the further annealing of the wheel to be steps which are entirely new in the making of wheels.

I do not herein claim the process by which my wheel is made nor the mold-flask employed in carrying out the process, as both the said process and the said mold-flask are claimed in my application for Letters Patent filed September 11, 1896, Serial No. 605,486, of which this is a division.

Having thus completely described my invention, what I desire to claim and secure by Letters Patent is—

1. A car-wheel having a cast-steel hub and rim connected by a series of spokes formed separately from the hub and rim, from a tough welding metal, and welded into the hub and rim so as to produce an integral wheel, substantially as described.

2. A car-wheel having a cast-steel hub and rim connected by a series of spokes formed

separately from the hub and rim, from a tough welding metal, bent to offset the hub from the rim, and welded into the hub and rim so as to produce an integral wheel, substantially as described.

3. A car-wheel having a cast-steel hub and rim and T-section spokes, formed separately from the hub and rim, from a tough welding metal, and welded into the hub and rim so as to produce an integral wheel, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FERDINAND E. CANDA.

Witnesses:
ALPHONSE KLOH,
HARRY M. MARBLE.