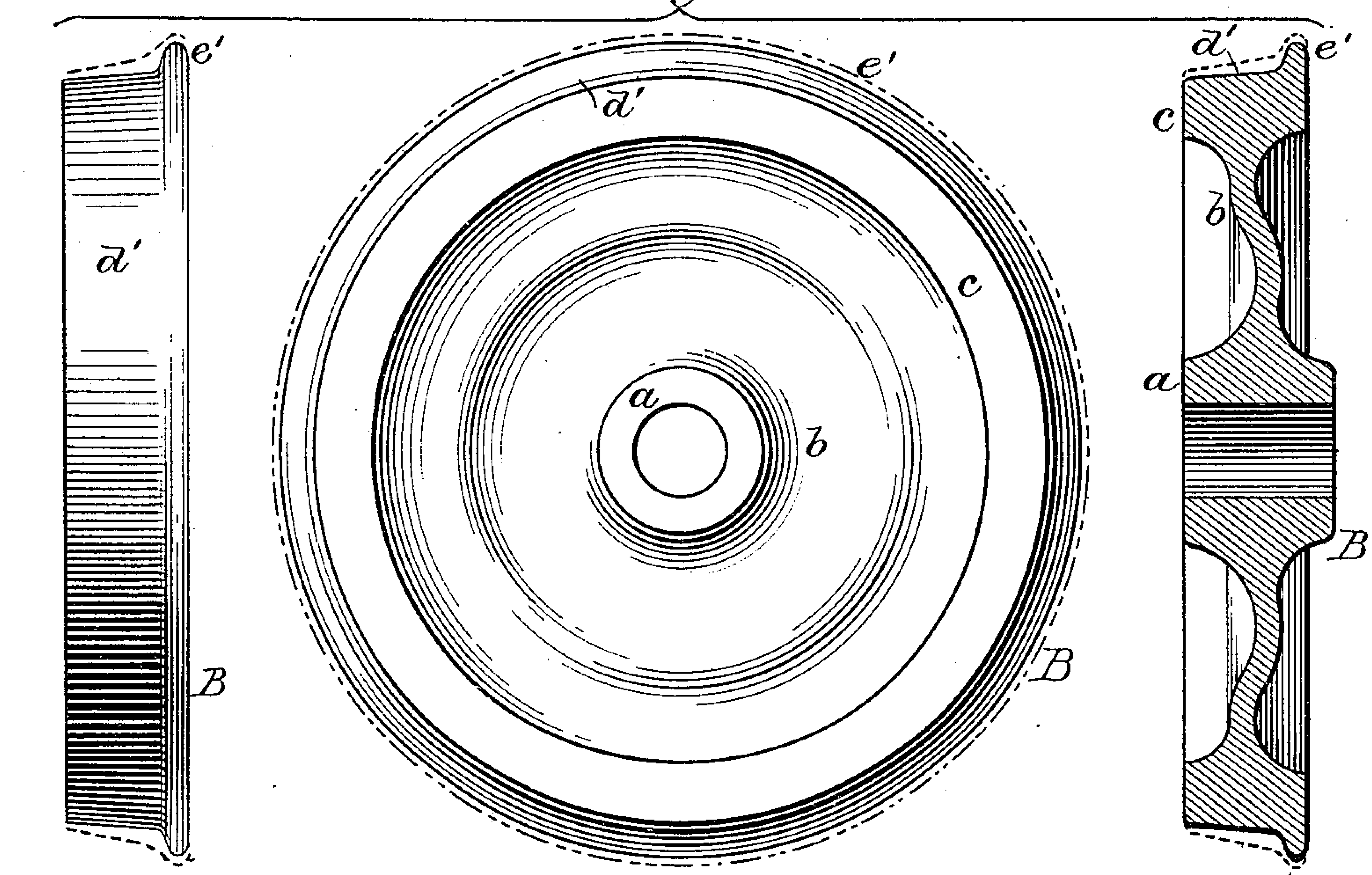
(No Model.) 3 Sheets—Sheet 1.

H. W. FOWLER.

CAST STEEL CAR WHEEL.

No. 351,431. Patented Oct. 26, 1886.

Fig. 1.



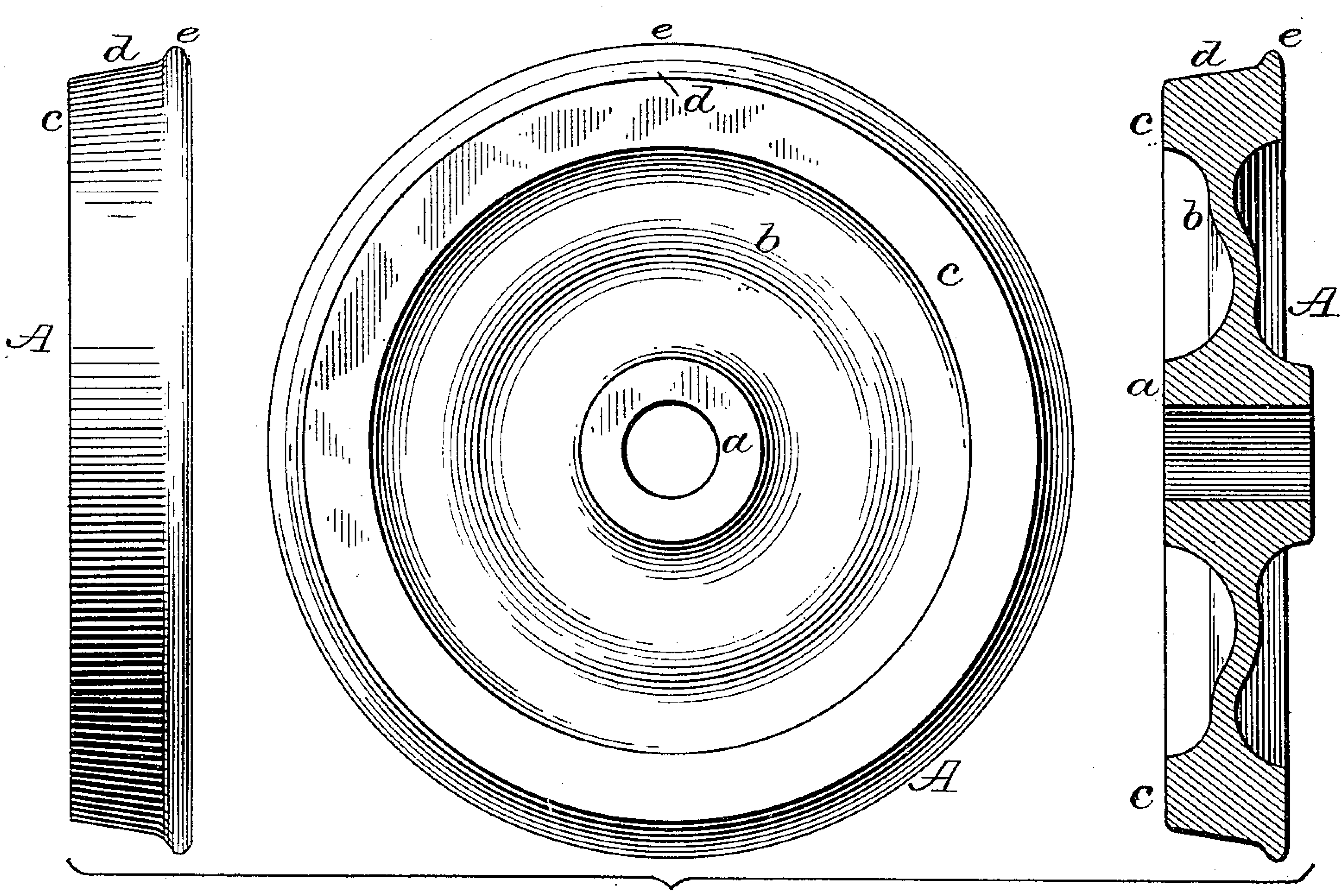


Fig. 2.

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(No Model.)

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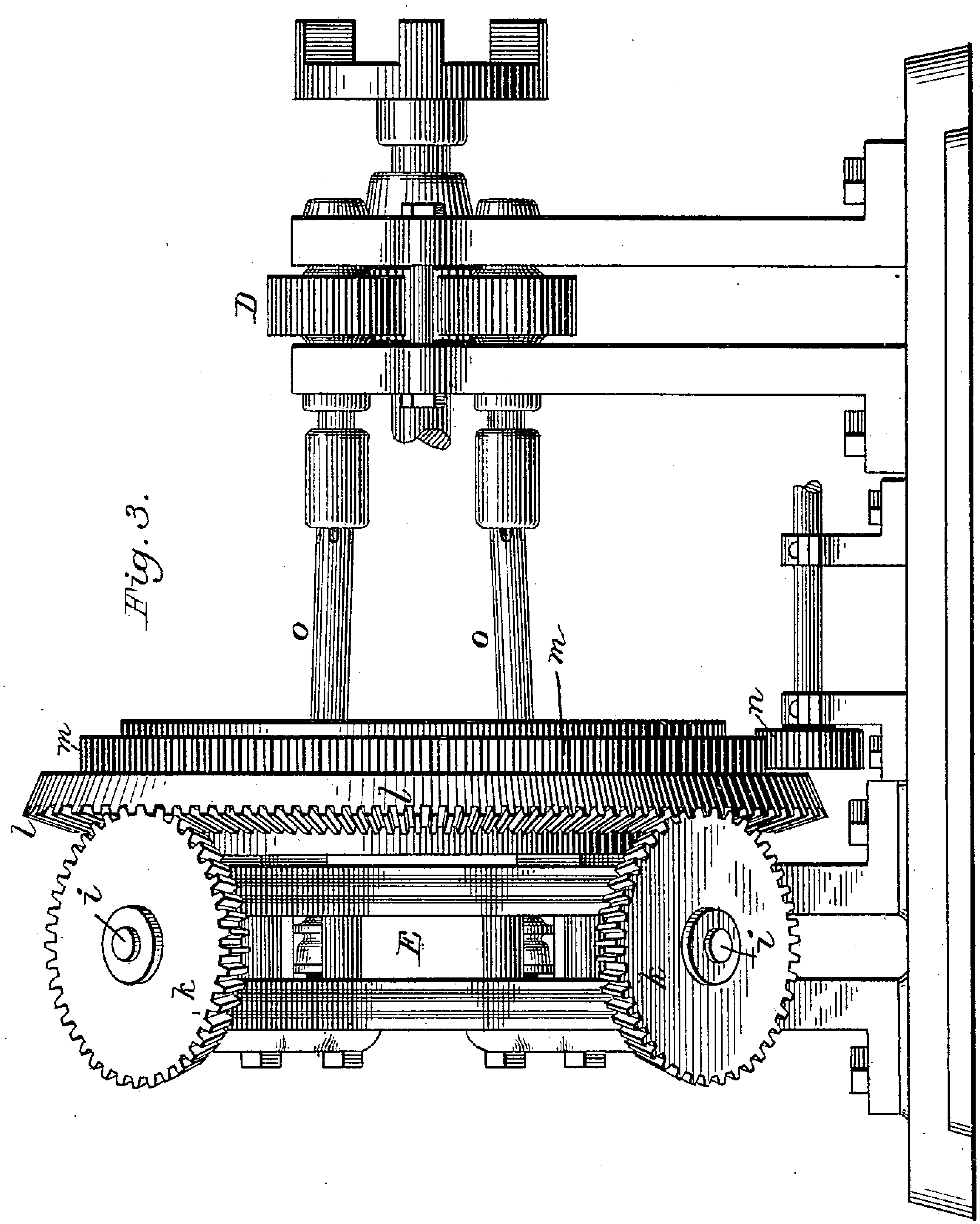
Fig. 3.



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3 Sheets—Sheet 3.

H. W. FOWLER.

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Fig. 4.

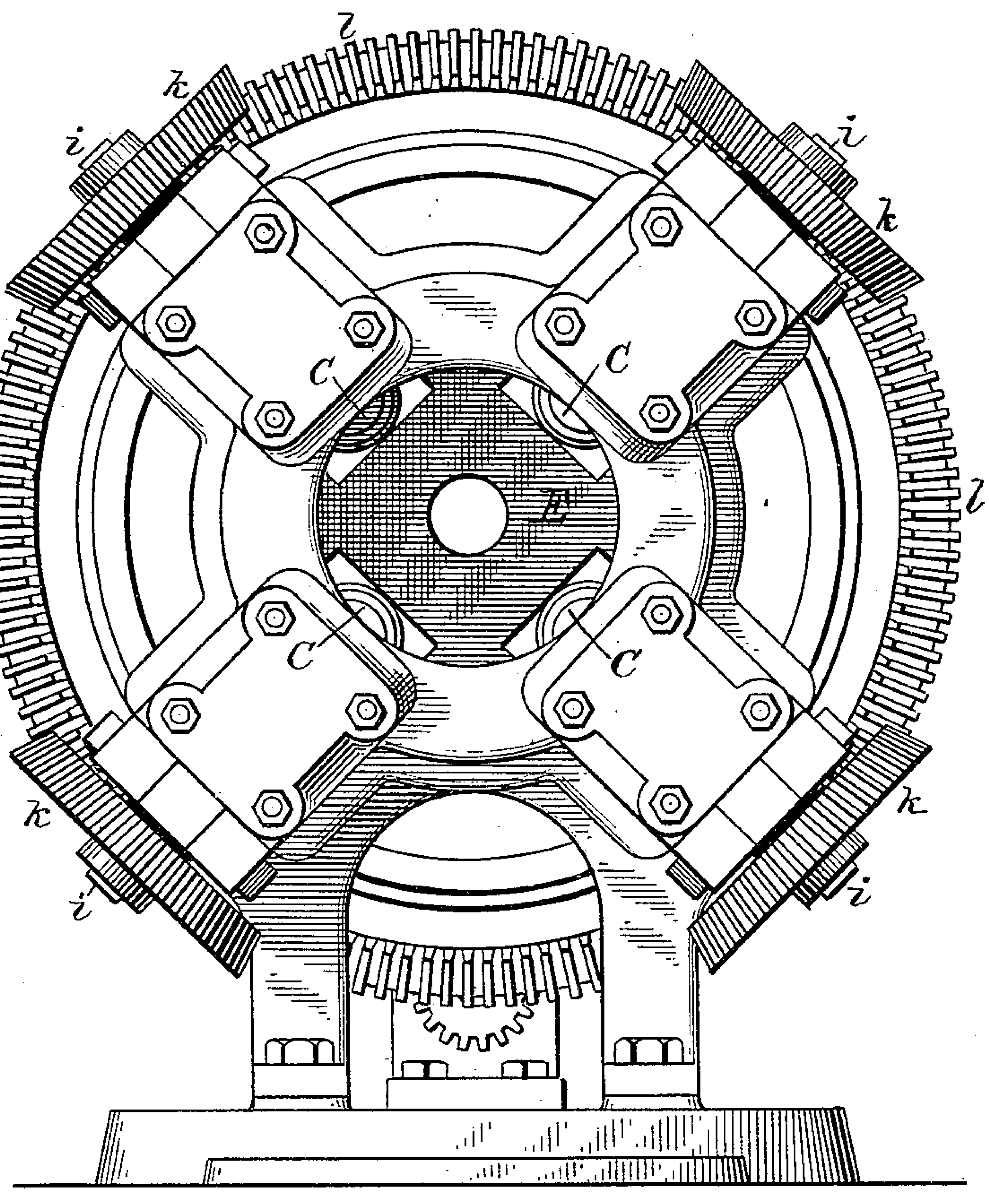
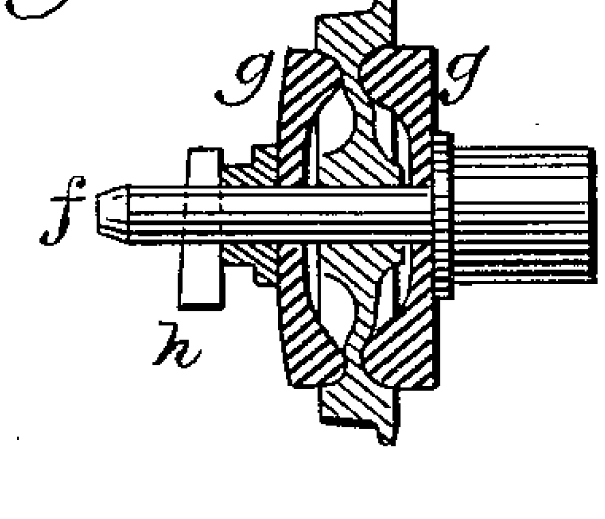


Fig. 5.



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UNITED STATES PATENT OFFICE.

HERVEY W. FOWLER, OF CHICAGO, ILLINOIS.

CAST-STEEL CAR-WHEEL.

SPECIFICATION forming part of Letters Patent No. 351,431, dated October 26, 1886.

Application filed April 30, 1886. Serial No. 200,683. (No model.)

To all whom it may concern:

Be it known that I, HERVEY W. FOWLER, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Cast-Steel Car-Wheels and in the Manufacture thereof; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part of the same, is a clear, true, and complete description of the several features of my invention.

The objects of my invention are to economically produce improved cast-steel car-wheels which are integral or solid, are truly concentric, and have the metal at the tread hardened and evenly condensed in radial and peripheral lines, and have the metal at the interior portions of the wheel, including the hub and web and a considerable portion of the rim, in its normal soft, ductile, and tenacious condition.

It has heretofore been proposed to manufacture cast-steel car-wheels by first casting a wheel-blank less in diameter than the finished wheel desired, and with an excess of lateral thickness at the rim, then compressing said rim laterally and expanding the periphery, thus forcing the latter against the face of a single driven roll occupying fixed bearings. A wheel thus produced would obviously have its entire rim condensed in lateral lines, and the metal at the tread could only be acted upon peripherally to an extent sufficient to correct the unequal peripheral expansion of the casting, and thereby to merely shape the tread and develop the concentricity.

Under my novel mode of manufacture I first cast a wheel-blank larger in diameter than the finished wheel desired, and having a rim substantially of the thickness desired in the finished wheel, and then, while confined against lateral expansion, various portions of the periphery are simultaneously subjected to the action of a series of rolls, which laterally embrace portions of the rim and are gradually advanced toward the center of the blank until the desired reduced diameter is obtained. The radical differences between said prior method and mine will be obvious when it is considered that under said prior method the metal at the periphery of the rim is first compressed laterally and the periphery forced outward, and that at the more porous portions of the rim a lateral consolidation must occur with little, if any, peripheral expansion, whereas at the more solid portions the greater expansion will occur, and hence it will be at these already solid portions that the roll will chiefly operate. By my method the slight variations in concentricity are first corrected, and then all the rolls take bearing, and as a consequence thereof the metal throughout the entire periphery is evenly condensed in radial and peripheral lines. It will also be obvious that under said prior method the particles or molecules of metal at and adjacent to the periphery which are forced outward are first shifted from their normal positions in the casting, and then partially returned toward said positions, whereas under my method the particles of metal at and adjacent to the periphery of the finished wheel occupy substantially the same position with relation to each other and to the interior particles that they occupied in the original casting, although they have been forced into more intimate relations, and with uniformity throughout the entire peripheral portion of the wheel. Under said prior method the tough, tenacious skin of the casting is peripherally stretched and attenuated; but under my method said skin is hardened and thickened, the peripheral dimensions of the condensed skin in the finished wheel being materially less than in the casting. Under said prior method the entire rim is condensed and hardened; but by my method only the metal at and adjacent to the wearing portions of the rim are thus condensed, leaving the remainder in its normal soft and tough condition, and well adapted to resist the well-known tendencies of a car-wheel to break on radial lines.

It has also been heretofore proposed to develop cast-steel car-wheels from castings in the form of disks, each of which is rolled to reduce its thickness and form the web, and also peripherally rolled to thicken or upset the edge of the disk in forming the rim, tread, and flange of a wheel, thus, obviously, neither involving my method, nor producing a wheel of the novel character sought and produced by me.

To more particularly describe my inventien, I will refer to the accompanying three sheets of drawings, in which—

Figure 1 illustrates, in side and edge views and in section, a cast-steel car-wheel as produced by me in accordance with my invention. Fig. 2 in a similar manner illustrates such a cast-steel wheel-blank as is used by me for producing the car-wheel illustrated. Fig. 3 illustrates in side elevation a machine well adapted for the practice of my invention. Fig. 4 illustrates said machine in front elevation. Fig. 5 illustrates a car-wheel in section, and clamping devices for internally supporting the rim while the casting is being operated upon by the machine.

The casting or wheel-blank A, produced in accordance with the first step in my process, is composed of suitable steel, and any kind of mold may be used for receiving the molten metal, provided it will afford a blank casting having a hub, *a*, and web *b*, of substantially the same form and dimensions as are required in a finished wheel, and also a rim, *c*, having the lateral thickness ultimately required. Said blank must, however, be materially larger in diameter at the tread portion *d* of the rim in the finished wheel, and also larger at the flange side and at the outer side, although at these two points the excess in diameter may be somewhat less than at the tread, all of which is fairly indicated in the drawings. As seen in Fig. 2, the wheel-blank has a partially-developed or rudimentary flange, *e*, and the tread *d* is unduly inclined, as compared with the tread of a finished wheel, B, Fig. 1.

It will be readily seen that the conversion of the wheel-blank into the wheel, Fig. 1, results in the condensation of the metal at the outer portion of the rim in radial and peripheral lines, and that the main condensation is located adjacent to the junction of the flange with the tread, that being the portion of the wheel exposed to the greatest wear. At the outer edge of the rim or tread the metal is also condensed in radial and peripheral lines, but to a lesser degree than at the tread. The metal in the entire flange is similarly condensed, although to a somewhat less degree than at the tread. During the condensing operation the outer portion of the rim is confined against lateral expansion, and the metal in the flange can, if desired, be condensed to a degree closely approximating to that at the tread. In Fig. 1 the dotted lines fairly indicate the peripheral outline of the cast-steel blank, and a comparison thereof with the adjacent outlines of the finished wheel will convey a fair idea of the variable condensation of the metal at the several portions of the periphery of the rim. The exact variations between the diametrical proportions of a wheel-blank and a finished wheel to be developed therefrom cannot of course be stated in a manner applicable to all cases, it being obvious that variations in the character of the metal and in the size of the wheel and in the bulk of the rim, as well as in the condition of the metal as to heat, would each and all render compensating variations in said relative proportions more or less desirable. As an instance, however, I will state that for producing a wheel thirty-three inches in diameter at the tread, and of the form illustrated in Fig. 1, I prefer to have a steel casting of about thirty-four inches in diameter at the tread, and at the inner and outer sides from one-half to three-quarters of an inch greater in diameter than the corresponding portions of the finished wheel. Under these conditions as to dimensions, and at a favorable heat, the wheel produced will possess great practical value, having a hub, *a*, and web *b* composed of metal in its normal condition, soft and tough, and the same will be true of the main bulk of the rim *c*, especially at its junction with the web; but the tread *d'* and flange *e'* will be in a desirably hard and condensed condition and truly concentric, and when under brakes well adapted to properly adhere to ordinary steel or iron rails. About one-half of the reduction stated will result in a highly-desirable wheel for light duty. It must not, however, be presumed that I restrict myself to rolling the steel wheel-blank while in a heated condition, when composed of specially soft steel, because it may, when in a cold condition, be made truly concentric and materially reduced in diameter, and a highly desirable and serviceable tread and flange developed thereon. In thus condensing the metal at the periphery of the rim in radial and peripheral lines the operation of rolling is involved; but I know of no metal-rolling mechanism suitable for the purpose, except such as has been devised by me for performing the second step in my method of manufacture, and such mechanism has been disclosed by me in my application for Letters Patent filed October 16, 1885, Serial No. 180,066.

As hereinbefore indicated, it is generally important that the hub and web of the casting be relieved from pressure in radial lines during the condensing operation on the periphery of the rim, although with a specially heavy ribbed web and a proposed light reduction in diameter, under highly favorable conditions as to heat and its distribution, the web may alone be relied upon to successfully resist such rolling pressure as might then be requisite at the periphery of the casting. As a rule, however, the casting should be clamped so as to fully support the rim internally, as illustrated in Fig. 5, wherein one form of clamp is shown, embodying a central bar, *f*, two clamping-cheeks, *g*, which peripherally conform to the interior surface of a rim, and a clamping-key, *h*, in a slot in said bar. Other forms of clamping devices may be employed, provided, always, that the requisite diametrical support for the rim is afforded by them. As shown, the bar *f* may at one end be a journal to occupy a bearing, and serve as an axis to revolve with the casting or wheel; but such a bearing is not essential, as will hereinafter be made apparent.

For reducing the casting in the manner desired, the rolling pressure must be applied at various points, and the rolls must have such size and contour as will enable each to laterally embrace a considerable proportion of the rim, and to develop the exact angle of tread and form of flange desired, and so that all of said rolls will co-operate in forming, in substance, a contractible and expansible car-wheel matrix capable of receiving a casting and uniformly reducing its rim in radial and peripheral lines. The machine disclosed in the drawings meets all of these conditions. The rolls C are four in number in the machine illustrated, and are arranged in a circle, and each is mounted in bearings radially movable, and each is actuated radially by means of a screw, *i*, carrying at its outer end a gear, *k*, and all of said gears mesh with a large annular beveled gear, *l*, which has a set of plain gear-teeth, *m*, meshed by a driving-gear, *n*, to which power is applied by means of a worm shaft and gear, (not shown,) so that the rolls may be simultaneously and evenly advanced under high pressures during the rolling operation, and then, for releasing the finished wheel, the rolls are simultaneously withdrawn, the worm-shaft being provided with suitable reversing-gear and operated by power preferably independent of the gearing which drives the rolls. Each of said rolls is positively driven by means of a set of gearing, D, and coupling-bars *o*, which are employed in connection with sockets, as is common with ordinary metal-working rolls.

Three rolls may be employed with fair results, but the greater the number of rolls (and in my aforesaid prior application five-roll machines are shown and described) the more perfect and rapid will the operation be, inasmuch as the wheel-forming matrix E will be all the more complete.

It will be obvious that wheels from the same size of casting, if desired for different lines of service, should be differently treated for securing the best duty-results—as, for instance, car-wheels intended for heavy traffic should have flanges and treads heavily condensed; but for fast light service the tread may well be condensed to a lesser degree, and the flange only so far condensed as to afford a desirable surface for contact with the rails, thus leaving the main portion thereof in a softer condition and reducing its liability to breakage; but in all cases the wheels would of necessity be truly concentric, and the tread would be practically uniform in density and hardness. My improved wheels, when so far worn in service as to be non-concentric, may be readily reworked into perfect wheels of lesser diameter at low cost.

The time actually involved in the operation of the machine in performing the second step of my method will seldom exceed two or three minutes, and but little time is required for placing the casting in position and removing the finished wheel.

My car-wheels can be readily distinguished from those produced by any prior method, in that the skin surface of the casting at the tread is not noticeably disturbed. The roll-marks at the outer and inner sides of the rim are plainly visible, and between said marks and the interior annular edges of the rim the surface is substantially in its normal condition, and when broken my wheels clearly indicate the fact that the condensation and hardening of the metal is restricted to the outer portion of the rim.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The method of manufacturing cast-steel car-wheels, substantially as hereinbefore described, the same consisting, first, in casting a solid integral wheel-blank having a rudimentary flange, a hub and a web substantially complete as to dimensions and form, and a rim which at the tread and flange is larger in diameter than the finished wheel desired; and, secondly, in peripherally rolling the rim and concentrically reducing the diameter of said blank to the diameter desired in the finished wheel, and thereby evenly condensing the metal at the outer portion of the rim in radial and peripheral lines and developing the flange and hardening the tread of the wheel.

2. As an improved article of manufacture, an integral cast-steel car-wheel having its hub, its web, and the main portion of its rim composed of the metal in its normal soft and tough condition, and a flange and tread composed of metal which is hardened and condensed in radial and peripheral lines, substantially as described.

HERVEY W. FOWLER.

Witnesses:
JOHN NELSON,
WM. H. GILLETTE.