2 Sheets—Sheet I.

A. L. BRICKNELL.

CASTING BELT PULLEYS.

No. 183,791. Patented Oct. 31, 1876.

Fig. 1.

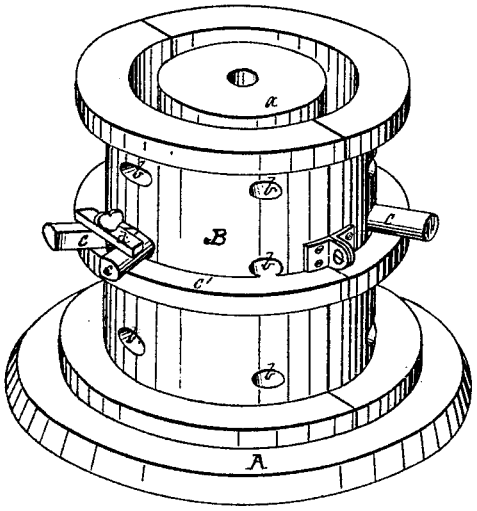


Fig. 2.

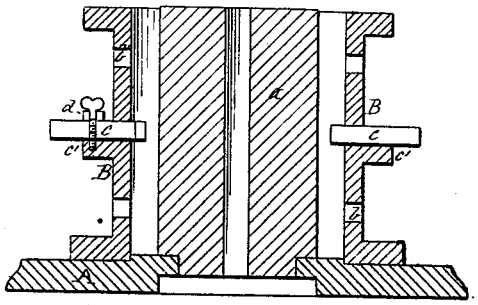


Fig. 3.

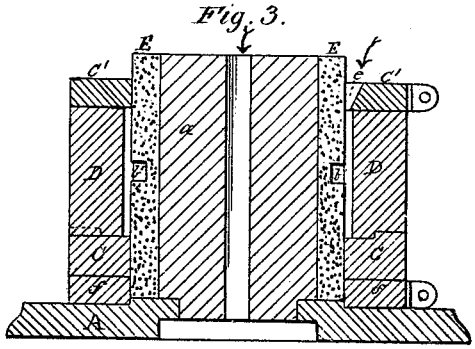


Fig. 4.

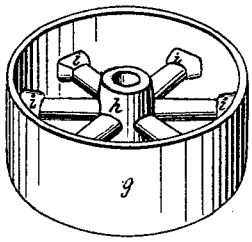


Fig. 5.

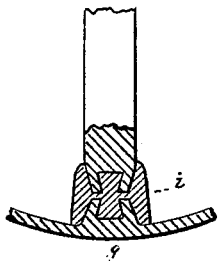


Fig. 6.

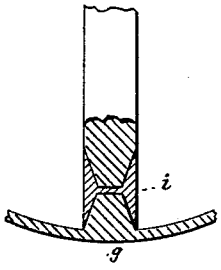


Fig. 7.

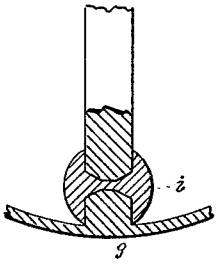
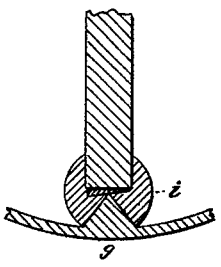


Fig. 8.



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Attorney

2 Sheets—Sheet 2.

A. L. BRICKNELL.

CASTING BELT PULLEYS.

No. 183,791. Patented Oct. 31, 1876.

Fig. 9.

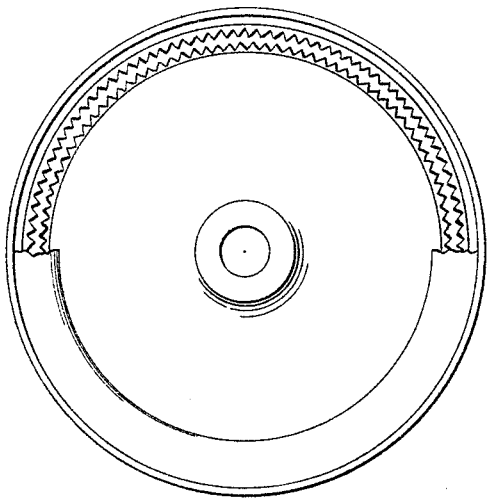


Fig. 10.

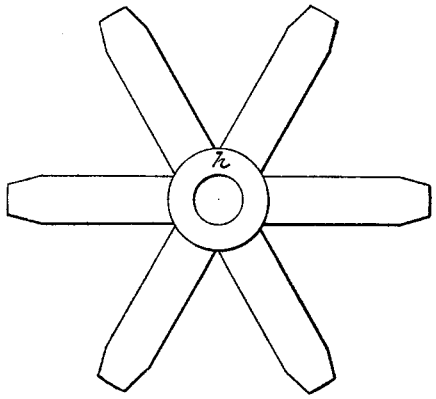


Fig. 11.

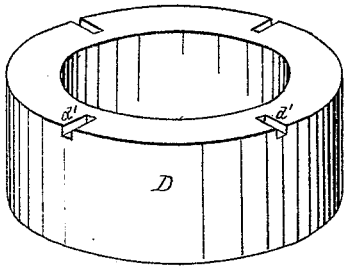


Fig. 12.

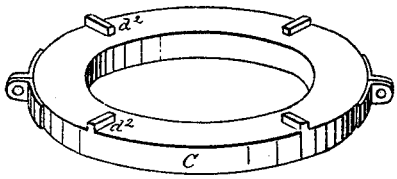
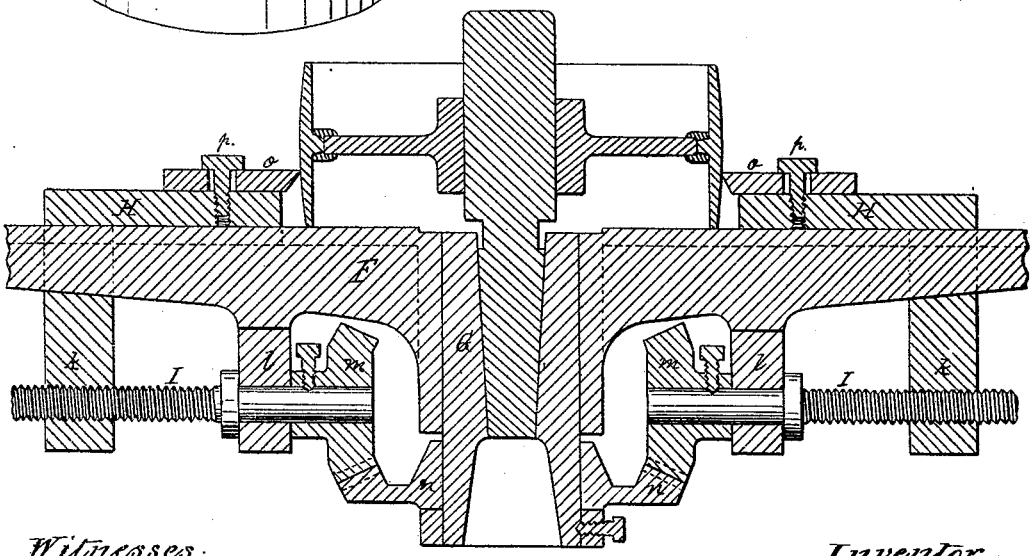


Fig. 13.



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UNITED STATES PATENT OFFICE.

AUGUSTUS L. BRICKNELL, OF LONDON, ENGLAND, ASSIGNOR OF ONE-HALF OF HIS RIGHT TO ALEXANDER A. HALL, OF NASHVILLE, TENN.

IMPROVEMENT IN CASTING BELT-PULLEYS.

Specification forming part of Letters Patent No. **183,791**, dated October 31, 1876; application filed May 4, 1876.

To all whom it may concern:

Be it known that I, AUGUSTUS LEA BRICKNELL, a citizen of London, England, at present residing at Nashville, in the county of Davidson and State of Tennessee, have invented certain new and useful Improvements in the Manufacture of Cast-Metal Belt-Pulleys; 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 my invention.

My invention has for its object the economical production of cast-metal belt-pulleys, having belt-faces which are well finished and practically concentric with their axes; and this I accomplish without the expensive machine-work heretofore necessary for producing pulleys having the recited characteristics. It is well known that, owing to the unequal contraction of the metal, solid cast-iron belt-pulleys have belt-faces which are irregular in their outline, and not truly concentric to their axes, and although such pulleys are sometimes used without the expenditure of lathe-work on their faces, their service is far from satisfactory, and they are never employed in first-class mills or factories. It is also well known that solid cast-iron pulleys are frequently unduly strained, either at the arms or rim, or both, so that although apparently perfect, and of the required strength, they are very liable to burst or break on receipt of any sudden strain or shock. To obviate this difficulty large cast-iron pulleys are sometimes cast in segmental sections, subsequently fitted and united, and their faces finished off in a turning engine or lathe.

My invention consists, mainly, in casting the rim of a belt-pulley in one piece, the hub and arms, or their equivalents, in one or more pieces, preferably in one piece, and in uniting the rim thereto while adjusted and maintained in a position concentric with the hub.

My invention further consists in casting the rim of a belt-pulley in a mold having a smooth, well-finished, permanent-face molding-surface and a yielding non-chilling core, whereby a belt-face is attained which requires no machine-finishing, and the irregular and uneven contraction of the metal is practically obviated. Belt-pulleys made in accordance with my invention are readily distinguishable from any others heretofore made; and my invention further consists in a belt-pulley having a solid separately-cast rim, which is united to the hub and arms by any suitable means.

I have demonstrated by practical operations that a pulley constructed in accordance with my invention is much less expensive than pulleys solidly cast, as heretofore, because the operations of molding and casting are greatly simplified, and it requires no machine-work on its face, either for attaining a desirable belt-surface or for securing concentricity. My pulleys, too, are stronger than those which are cast solidly, because they are never under that strain which is incident to the contraction of cast metal. It will be obvious, so far as the casting is concerned, that pulleys cast in segmental sections are more costly than those cast solidly; but if there be more than one arm in any one section, the strain due to contraction exists to a greater or lesser extent. The segmental pulleys also require machine-work on their faces to secure concentricity, and to afford a proper belt-surface. As compared with these segmental sectional pulleys, mine are cast at a much less cost, and require, as before stated, no machine-work on their faces.

For permanent-face mold-surfaces I can employ any of the well-known matters and compounds—for instance, plaster-of-paris, plumbago, &c.; or, as I in practice prefer, a cast-iron chill may be employed.

To more particularly describe my invention, I will refer to the accompanying drawings, of which two sheets are furnished.

Figure 1 represents, in perspective, a mold such as I prefer to employ for forming a suitable core. Fig. 2 represents the same in diametrical vertical section. Fig. 3 represents, in sectional view, the sand core and chills in proper position, and a cast pulley-rim remaining in the mold. Fig. 4 represents, in perspective, one of my improved pulleys. Figs. 5, 6, 7, and 8 represent different forms of joint between pulley arms and rim. Fig. 9

represents a pulley having a solid web instead of arms. Fig. 10 represents a hub and its arms. Fig. 11 represents, in perspective, a chill bottom side up. Fig. 12 represents, in perspective, a circular base-plate right side up. Fig. 13 represents, in section, a centering-table, such as I prefer to employ for adjusting the parts of which my pulleys are composed, and for maintaining them in proper position while being united.

Referring to Figs. 1 and 2, A denotes a base-block, which constitutes the bottom of my mold. A vertical cylinder, as at *a*, is mounted centrally thereon, for the purpose of obviating the use of a greater quantity of sand than is actually requisite for forming a suitable core. Moreover, the core thus formed is better adapted to afford a more uniform resistance to the contraction of the metal in cooling than would be the case if no central block were employed. B denotes a sectional cylindrical shell or core-box, which constitutes the vertical sides of the core-mold. Preferably this shell will be made in two pieces, each being semicircular, and of such a height as will render them available for casting pulleys with as wide a face as would ever be required on pulleys of a diameter equal that of the mold. The shell B is provided with apertures *b* at intervals, for the reception of detachable prints *c*. These prints will be of such form and dimensions as may be required in each case for providing at the inner side of the rim of the pulley a point of connection with the hub or its arms. For making pulleys with one series of arms, the outside of the shell is provided with an outwardly-projecting flange, as at *c'*, located midway between top and bottom, and the lower sides of the print-apertures *b* are in the same plane with the upper side of the flange *c'*, so that the prints *c* will have a good bearing or support thereon. In some instances the prints are made in one piece, when capable of easy draft, and sometimes in two pieces, in which case they are confined in position by means of a cross-bar, as at *d*, and a clamp-screw passing through the flange. When the prints are in two pieces, and set angularly to each other, I provide recesses in the flange and projections on the prints, so that the prints may be readily and accurately adjusted with relation to each other. The parts or sections of the shell are united by means of flanged ears and bolts. When the shell is arranged for making pulleys with two series of arms, it is provided with a flange adjacent in like manner with each series of print-apertures *b*. It is obvious that the depth of the prints may be varied.

Referring next to Fig. 3, C denotes a circular cast-iron base-plate, mounted upon the base-block, and having an interior diameter equal to the inside diameter of the pulley-rim desired; and C' denotes a cap-plate of a similar character. D denotes a cast-iron "chill," preferably cast in one piece, and having its interior surface concaved to a greater or lesser extent, corresponding to the degree of convexity of the belt-face of the pulley desired, and having a width corresponding with the width of the face of the pulley-rim to be cast.

Instead of being concaved, the chill-face may be straight, so that for wide straight-faced pulleys two or more chills may be employed, one over the other.

In Figs. 11 and 12 I show the lower edge of a chill and the upper surface of the circular base-plate C. The chill is supported by the base-plate, and to readily adjust and secure them in position relatively to each other I provide the radial recess d^1 on one, and the radial lugs d^2 on the other, which, being correspondingly located, operate as dowels, and at the same time admit of the proper unity of the chill and the plate when they are expanded by heat, as is liable in their use.

With the several parts of the mold thus constructed, I proceed as follows: The sectional shell B is placed in proper position, with the prints duly adjusted. The annular space between the central block *a* and the shell is then rammed with sand, the detachable prints removed separately, and the sections of the shell separated and removed, leaving the cylindrical core as at E, Fig. 3. The circular base-plate C is then placed in position, surrounding the core. The inner portion of its upper surface constitutes a mold-surface for one edge of the pulley-rim. The chill D is then put upon the base-plate. The space between the inner surface of this chill and the exterior surface of the core E determines the thickness of the pulley-rim. The cap-plate C' is then placed on top of the chill, which completes the mold, the inner portion of the lower surface of said cap-plate constituting the molding-surface of the other edge of the pulley-rim. With the parts thus adjusted the melted metal is poured *via* the gate *e*, formed in the inner edge of the cap-plate.

It is in some cases preferable to pour the metal through a vertical duct in the center of the core; thence into the mold by curved or straight lateral ducts to an annular gate recessed into and surrounding the core at its base, and communicating with the mold by a space equal to about half the thickness of the rim of the pulley desired.

It will be seen that the chill will secure a smooth and proper finish to the belt-surface of the rim, and that the sand core will permit uniform contraction, and thereby secure a rim which is practically circular. In Fig. 3, at *f*, I show a support for the circular plate C, whereby the chill may be set at a proper height with relation to the prints at *b'*. When narrow-faced pulleys are made, the lower series of print-apertures *b* in the chill B may sometimes be employed, in which case the plate C may be placed directly upon the base-block A. In general practice, however, the supports *f*, of various heights, are required for securing accurate adjustment of the chill.

The hubs of my pulleys may be cast in sand, although I prefer to cast them in vented iron molds, with a view to lessening their cost as far as possible. However they may be cast, they will be provided with arms, or in some cases with a web, for connection with the rim.

In Fig. 4 one of my improved pulleys is shown. The rim *g* is separately cast solidly, on a chill or other permanent mold, as already described, and the hub *h* separately cast with the requisite number of arms, which are united to the rim in each instance at *i*.

At Fig. 5 I show a segment of a pulley, illustrating one of the best connections known by me for uniting the rim and arms. The prints, being made in two parts, as previously referred to, form on the inner side of the rim a projection having a central dovetailed recess, and the adjacent end of the arm is provided with a similar recess. An adjustable hand-mold, with or without clay joints, is made to inclose the joint, and the melted iron or other metal is poured therein, which, when cooled, solidly unites the arm and rim. The form of this joint is such that the metal surrounding it has freedom to contract, without in any manner disturbing the relations of the parts; but, on the contrary, said contraction is favorable to securing a desirable unity of the parts.

Figs. 6, 7, and 8 represent other forms of joints which may be employed with good results. Fig. 8 illustrates clearly a wedge interposed between the pulley arm and rim. In some cases a web is desirable between hub and rim instead of arms. Pulleys of this class may readily be made in accordance with my invention, as it will only involve a shell, B, provided with apertures for prints, which will provide an inward annular projection from the rim with a serrated edge, and the casting of the hub with a web having a similar edge, the two parts being united by a cast-metal joint, as illustrated in Fig. 9. In some cases pulleys with rims of great width require two series of arms. In casting such pulleys solidly, as heretofore, the unequal contraction of the metal is a serious obstacle to the attainment of good results. It is obvious that the arms of the hub must correspond in the positions relatively with the projections on the rim with which they are to be united. Should two series of projections be cast with the rim they would always be regular and uniform in position with relation to each other; but two series of arms cast solidly with a hub would seldom be uniform and regular in position with relation to each other, owing to their liability to warp and twist in cooling. In casting a hub with two series of arms solidly in a chill, the metal in that portion of the hub which is between the series of arms would, in contracting, be fractured, on account of the unyielding character of the chill and the expansion thereof by heat. Therefore, in making this class of pulleys, I cast a solid rim, as before described, with the two series of projections, but cast my hub in two parts each, with a complete series of arms; or in other words, I cast two separate hubs each with its arms, as for a pulley with one set of arms. These two hubs are placed side by side, with their adjacent ends in contact, so that each series of arms will occupy a proper position with relation to its proper series of projections on the rim, to which they are united, as before described. Inasmuch as the two hub-sections are in close contact with each other and are truly reamed, they can be readily and safely driven to and fro on a shaft longitudinally, and being held to the shaft by separate set-screws, they will be united therewith in like manner as if the hub were solid.

For properly adjusting the hubs and rims, I find that it can be quickly and economically executed by use of a centering-machine, which is illustrated at Fig. 13 in central vertical section.

F denotes a circular table, mounted on a vertical hollow spindle, G, and arranged to rotate thereon. The table is provided with four radial slides, H, which are fitted in radial slots, and are provided with a downwardly-projecting arm, *k*, having a tapped hole near its lower end, parallel with its line of motion. The table has also four hangers, as at *l*, in which are bearings for screws I, which enter the tapped holes in the arms *k* of slides H. The inner ends of each screw carries a bevel-pinion, as at *m*, which meshes with a large stationary bevel-gear, as at *n*. It will be seen that if the table F be rotated in one direction, all the slides will be simultaneously moved outward, and vice versa. At the inner end of each slide H is a longitudinally-slotted adjustable finger, *o*, which is secured to the slide by a set-screw, *p*, thereby admitting of the nicest adjustment with relation to a center common to all of the slides. A mandrel is placed in the hollow spindle G, and a hub placed thereon already properly reamed. A rim is then placed upon the table, which is then rotated, thereby adjusting the rim to a truly concentric position with relation to the hub, and while in that position the cast-metal joints are formed as near simultaneously as possible, and the pulley completed.

Instead of having the table movable, it may be stationary, and the gear *n* arranged to rotate on the hollow spindle, so that a crank attached to one of the screws I will, on being rotated, actuate all the screws simultaneously. While I prefer to use cast metal at the joints between rim and the hub or its arms, I am aware that approximately economical results may be obtained by uniting the rim with the hub by means of bolts or rivets, and I do not, therefore, limit my invention to the use of cast metal at the joints.

It is to be distinctly understood that my improvements relate exclusively to belt-pulleys, and that my prime object is economy in the manufacture of cast-metal belt pulleys, having, in a practical sense, a truly-concentric rim and a well-finished face.

I am aware that it is not new to make belt-pulleys with a wrought-iron rim and cast-metal hub and arm; but such pulleys are devised for special or extraordinary service, and are constructed, comparatively speaking, regardless of expense.

In connection with the manufacture of wheels for cars and other vehicles, I am well aware that such wheels have been made with a flanged or other rim, cast with its tread on a chill and its rear side on a yielding chilling-core, and that such rims have been united to a hub and arms, or their equivalents, in various ways. It is well known, however, that the manufacture of car or other similar wheels, considered in itself, is an art separate and distinct from that of manufacturing belt-pulleys. The conditions involved in their manufacture are widely different, although both are produced under the general art of casting metals. In the car-wheel the heavy rail-flange renders the contraction of the cooling metal comparatively uniform.

A car-wheel constructed with a separate solid flange and separate hub and arms, or their equivalents, is more expensive than the solidly-cast wheel, and the object of this more costly divisional construction is to render it possible to replace a worn-out rim with a new one without disturbing the hub and axle.

The casting of the car-wheel flange-rim on a chill secures a smooth surface; but it has been proven to be advantageous to turn off the chilled iron to a certain depth, so that the originally smooth surface is not available as an item in economy.

With the belt-pulley, a belt-surface which is harder than ordinary cast-iron has no additional value on account of its hardness, the desired end being a smooth, well-finished surface. The car-wheels have heavy rail-flanges and treads, involving the use of very considerable bulk of metal, which is heavily distributed throughout the wheel, and therefore no practical difficulty is experienced in attaining concentricity of the flange and tread with the axis of the wheel. On the other hand, the rim of a belt-pulley is extremely thin, usually as light as possible, while the hub and arms necessarily involve the massing of more metal than is frequently required for the entire rim. Incidental and in addition to that prime economy attained by my invention through lessening the cost of molding and obviating machine-work on the belt-face, there are other minor points all contributing to the same end. For instance, I am enabled to use iron of full grade for my rims and half-grade iron for my hubs and arms, which in itself is an economic item of very considerable importance. No such possibility exists in car-wheels, for none but the highest grades of iron can be used in their manufacture.

Cast-metal pulleys, as heretofore made with machine-finished faces, must, of necessity, be composed of fine high-grade iron throughout, while, although I can use two grades of iron, as before indicated, a thoroughly serviceable pulley can be made, by means of my invention, wholly of low-grade iron, because no machine-finishing is necessary. It is true that low-grade iron is not so strong as the high-grade; but it is to be remembered that in the solidly-cast pulley much strength is requisite for resisting the strain incident to contraction, while in my pulley no such strain exists. Now, referring to my mold, it will be obvious that its first cost will be equal to or perhaps greater than the cost of a pattern as usually made, and the flask with which it is used; but it will be seen that the cost of a multiplicity of patterns is obviated. An ordinary regularly-graded list of pulleys of upward of two hundred in number embraces but twenty-nine diameters, and therefore twenty-nine core-molds, as employed by me, will be sufficient for producing rims for the entire list, each core-mold being suitable for the widest face, and, of course, any narrower face of the same diameter. So, also, will twenty-nine pairs of the circular cap and base plates serve for the entire list; and for making wide straight-faced pulleys, two or more narrow chills may be employed, one above the other, although, for making convex-faced pulleys, a concaved pulley will be requisite for each diameter and width of pulley required.

If the hubs and arms be cast in a sand mold, the patterns therefor can readily be made so that additions to hub and arms may be at will provided, attached or detached, for matching with rims of various widths of faces.

I am also enabled to cast a hub and arms on a chill, which, while it adds in no manner to their actual value, lessens the cost of casting as compared with the common methods, and secures a desirable finish. From this comparison of the manufacture of wheels for vehicles with the manufacture of belt-pulleys, it will be seen that my invention is not based upon previous results in the manufacture of such wheels, for that which rendered those wheels more expensive renders the belt-pulley less expensive; also, that the desirable capacities in the car-wheel, for instance, of admitting the replacement of an old flange with a new one, has no value in the belt-pulley; also, although even if a hardened chilled surface on the car-wheel flange did possess value, which is not the case, a similar surface on the belt-pulley has no value by reason of its hardness.

Incidental to my invention, it will be seen that thereby practically perfect belt-pulleys may be made with but little outlay for tools, other than the molds, which, in cost, will seldom, if ever, exceed cost of patterns, as heretofore required in the regular manufacture of pulleys extensively conducted.

For fitting my hubs a reamer is only requisite, and key-slotting, or the set-screw and its threaded seat in the hub, involves the use of simple mechanisms and the employment of low-priced labor. The centering-machine is readily adapted to pulleys of various diame-

ters. None of the usually-employed face-finishing tools are requisite, and the manufacture of pulleys is greatly simplified.

Practical operations have demonstrated that pulleys can be made in accordance with my invention, and in every essential particular fully meeting the existing requirements of the trade, at a cost of from twenty-five to fifty per cent. less than the cost of pulleys of the same size manufactured by the methods in vogue prior to my invention.

It is to be distinctly understood that I make no claim to the particular construction or arrangement of the parts constituting my molds, nor to any particular form of joints between the solid central portion of the pulley and the separately-cast rim, for I am aware that molds somewhat similar have been heretofore employed in casting solid belt-pulleys and sectional car-wheels, and that in the manufacture of such car-wheels a great variety of joints has been proposed at the junction of the rim with the hub or arms projecting therefrom.

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

1. The improvement in the manufacture of cast-metal belt-pulleys, which consists in casting a solid rim in a mold, having a yielding non-chilling core and a permanent face-surface, substantially as described, whereby a well-finished belt-face and a practically circular rim are economically attained, as set forth.

2. The improvement in the manufacture of cast-metal belt-pulleys, which consists in separately casting the hub and the rim, the former, with its arms or their equivalents, being cast in any suitable manner, and the latter cast in a mold having a permanent face-surface and a yielding non-chilling core, the two parts being concentrically arranged and united together at the joints, substantially as described, whereby smooth-faced and practically concentric pulleys may be economically produced, as set forth.

3. A belt-pulley having a solidly-cast rim and a separately-cast hub, with arms, which are united to the rim, substantially as described.

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