

Dec. 4, 1934.

A. L. LEE

1,983,177

MINE CAR WHEEL

Filed Jan. 16, 1933

2 Sheets-Sheet 1

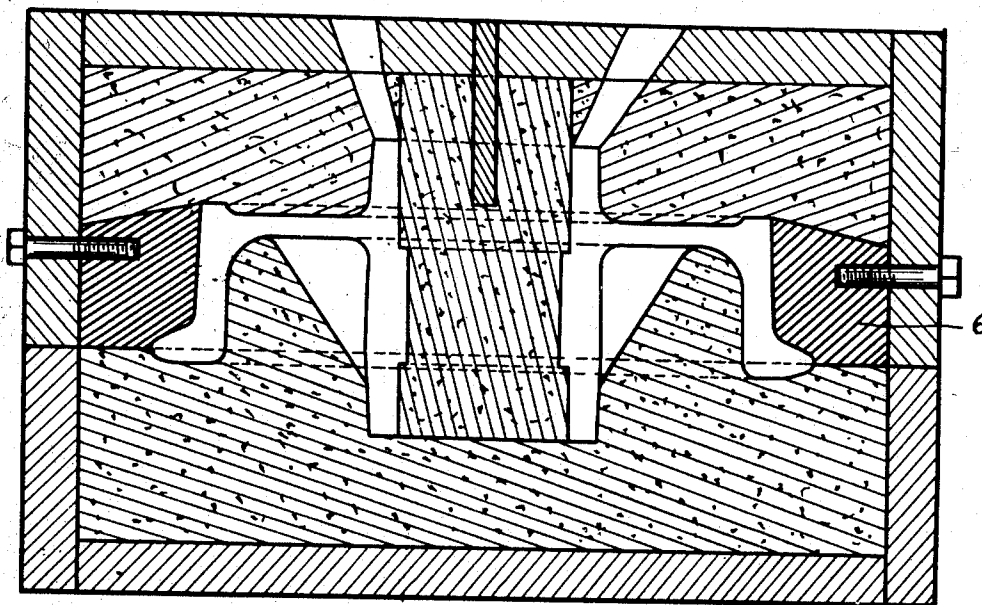


Fig. I

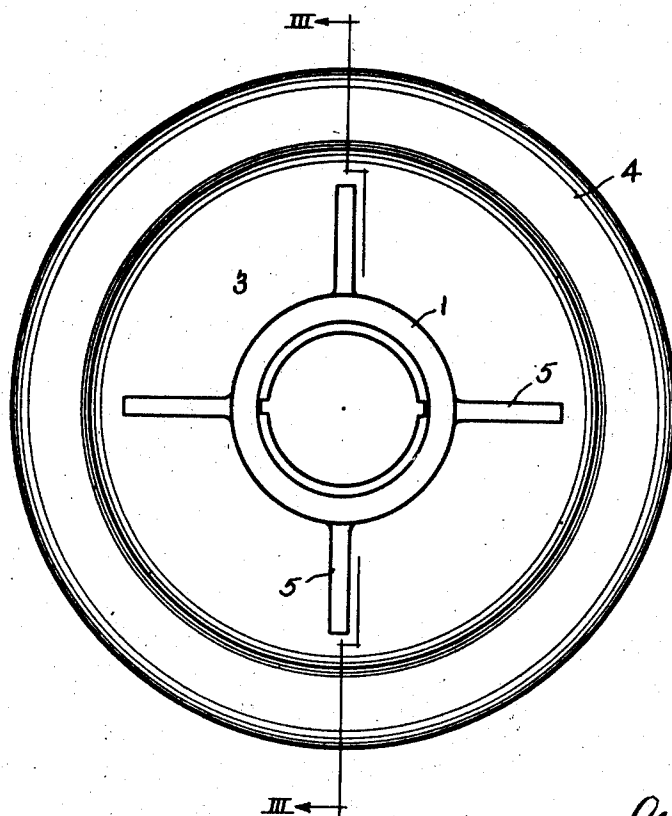


Fig. II

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2 Sheets-Sheet 2

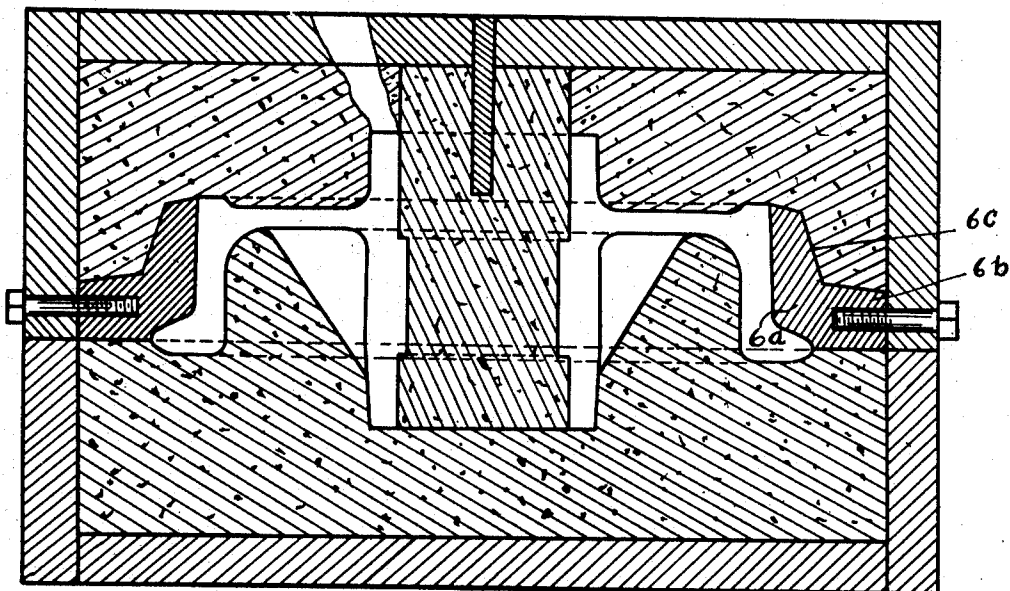
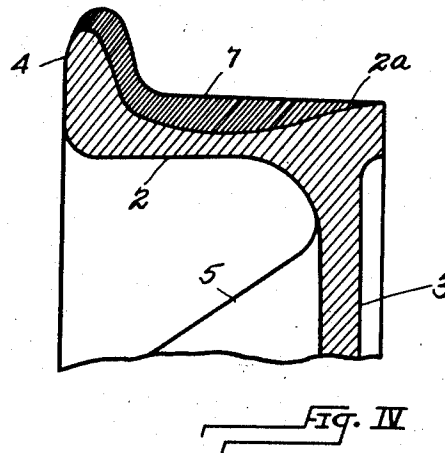
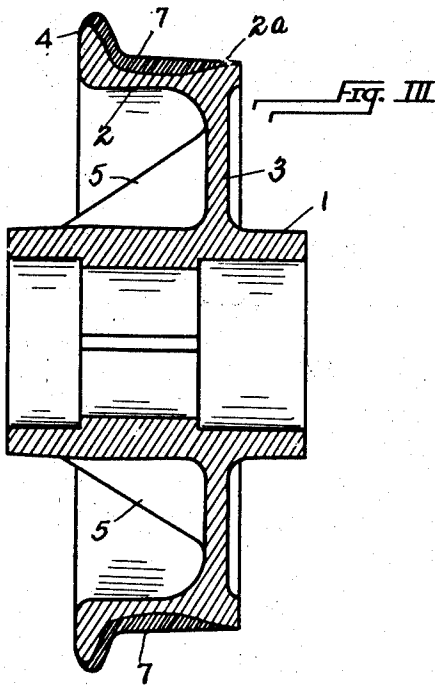


Fig. V

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UNITED STATES PATENT OFFICE

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MINE CAR WHEEL

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4 Claims. (Cl. 295—30)

This invention relates to a wheel for mine and industrial cars.

Under present-day mining conditions, particularly in coal mines, automatic loading has caused an increase in the size of mine cars and a more vigorous use of the cars, with increased speed at which the cars are propelled and an increased number of daily trips for each car. Under present practice mine cars are also increased in size and loaded capacity, and because of space limitation increased height of the cars has been partially compensated for by decreased diameter of the car wheels.

This modern mine practice has resulted in greatly decreasing the useful life of mine car wheels, flat spots generally developing on the tread of the wheel in the third or fourth year of its use. I have discovered that the flat spots on the treads of the wheels occur in a particular location, which is diametrically outward of the wheel spokes, showing that the wheel tread is less durable at these points. I have found that the presence of areas of less resistance to wear in the treads of the wheels results from the standard foundry practice by which mine car wheels are made, which practice I shall herein briefly describe.

Mine car wheels are made of cast iron, or an iron in which some small percentage of alloying metal is included. In casting the wheels a chill, in the form of a metallic band of considerable heat capacity, is so positioned in the flask that it is in contact with the molten metal which solidifies to form the outer surface or tread of the wheel. The function of this chill is to produce a rapid solidification of the tread metal, so that the internal change, incident to the slow cooling of cast iron does not occur, and a tread layer of "white" cast iron containing a relatively high percentage of combined carbon is formed in the felly.

The hub of the wheel, however, is of considerable body, and the spokes leading from the hub to the felly of the wheel place the felly, in the regions of each of the spokes, in heat communication with the molten metal which is to form the hub. The spokes themselves thus provide an increased volume of molten metal in particular regions, and also serve as heat feeders from the hub to the felly. The result is that, as the chill itself becomes heated, the felly is reheated by the heat reservoir comprising the hub and spokes. This results in producing throughout the greater proportion of the felly thickness the very changes in metallic structure which the chill is employed

to avoid. On fracturing a wheel of the spoke form, so cast, it is found that the chilled, or "white," cast metal extends inwardly from the tread surface a much lesser distance in the region of each of the spokes than in the regions which are not diametrically adjacent a spoke.

A further undesirable effect present in the casting of a spoked wheel is that the mass of metal constituting the hub and spokes contracts more slowly than the body of metal forming the felly of the wheel. Stresses are thus set up due to the tendency for the spokes to pull away from the felly. When this tendency is counteracted, as is usual, by placing the wheels in a soaking pit after casting, the annealing effect produces structural changes in the metal decreasing the hardness of the chilled tread. If a disk wheel of usual form, having a disk disposed centrally of the felly, is cast, there is a tendency for the disk to pull away from the felly at all points, and such wheels must also be soaked in order to relieve the stresses thus set up. In such a disk wheel also the disk serves, similarly to the spokes, as a heat feeder to the felly, and thus serves to decrease the thickness of the chilled tread metal all around the wheel.

Since, moreover, the tread hardness, produced by use of a chill, extends uniformly throughout the width of the tread, as wheels have been previously made, the region of the tread width which is subjected to the greatest wearing effect wears more rapidly than the remaining width of the tread. Thus the treads of mine car wheels as previously made tend to channel in the circumferential region adjacent the flange, in which region a wheel is in contact with the track.

In order to avoid these various disadvantageous features I have devised a mine car wheel of such conformation that during the casting of the wheel compensation is made for disadvantageous effects. In my wheel, as a product of manufacture, the tread hardness is of substantially uniform depth circumferentially of the wheel, with a relatively great thickness of chilled or "white," metal in such portion of the width as is subjected to the greatest wearing effect. The depth of chill moreover is roughly graduated from the region adjacent the wheel flange to the outer edge of the tread, so that a wheel wears with substantial uniformity throughout the width of the tread. It may be generally stated that my wheel is formed in conformity with problems arising from the casting operation by which it is produced, with the thought of producing a wheel of greatly increased life in service.

In the accompanying drawings Figure I is a vertical sectional view through a foundry flask, illustrating the casting of my specially shaped wheel; Figure II is an inner face elevation of my wheel; Figure III is a vertical sectional view through the wheel itself as an article of manufacture, taken on the line III—III of Figure II; Figure IV is a fragmentary view, on an enlarged scale, illustrating the depth of chill throughout the tread width of my wheel; and Figure V is a vertical section through a foundry flask, illustrating a modification in the casting of my wheel.

My improved wheel comprises a hub 1 and felly 2 contoured as is usual in mine car wheels. Instead of providing spokes, however, I form the wheel with a disk 3 extending between the hub 1 and felly 2 of the wheel. I am aware that mine car wheels have been made of disk type with a disk joining the hub and felly.

With reference particularly to Figure III of the drawings, it will be seen that my disk 3 is positioned at the outer edge of the felly, and is not positioned, as is usual in such type of cast wheel, approximately midway of the width of the felly. As will be seen in Figure II, disk 3 is of substantial thickness and its face lying inwardly, or toward the flange of the wheel, is dished, giving a greater depth or thickness of metal at the inner junction of the disk and felly. In order to strengthen the structure I provide a plurality of webs 5 extending angularly from the outer face of the disk to the hub of the wheel. As shown these webs 5 have no contact with the felly 2 of the wheel, and it is of importance that they do not have contact with the felly of the wheel in any region closely adjacent the flange 4. The reason for this arrangement of the supporting webs will be explained in describing the manufacture of the wheel.

Referring to Figure I of the drawings, it will be seen that a chill 6 is provided in the flask surrounding the mold cavity which is to form the felly of the wheel, and in such position that the surface constituting the tread of the wheel will be in contact with the chill when the metal is poured. When the metal for the wheel is poured into the mold, the chill causes rapid solidification of the metal in contact with it, thus producing a greater hardness than would occur if the metal were permitted to cool slowly.

It may now be noted that, because of the positioning of disk 3 and webs 5, there is no body of metal extending from the hub metal to the portion of the felly adjacent the flange. This region of the felly is, therefore, not subjected to a flow of heat from the mass of molten metal constituting the hub and the metal constituting the disk. The chill effect, therefore, is not reduced in this region adjacent the flange of the wheel, but in this region remains present to a relatively great depth. Heat flow radially outward from the hub is concentrated directly in the transversely outer circumferential region 2a of the felly, in substantial degree counteracting the effect of the chill in this region, and consequently lessening in this region the depth of the chilled effect.

Referring to Figure IV of the drawings it will be seen that adjacent the outer edge of the felly the chilled metal of the tread forms substantially a skin on the tread, and that the chilled effect is of greatly increased depth in the tread region which lies upon a rail, and in the flange of the wheel. The thickness of the chilled metal 7 extends diametrically inward

from the tread in its greatest depth where the hardness is most needed; and since conditions are uniform throughout the circumference of the wheel, the depth of the chill is substantially uniform throughout the wheel circumference. The transversely outer region of the wheel felly, in which the tread is subjected to less wear, is hardened to a lesser depth, so that the tread wears with substantial uniformity throughout its width, and a channeling effect in the region contacting the rail is prevented.

Referring again to Figure I of the drawings, it should be explained that it is highly desirable to so prepare the mold that the flange 4 of the wheel will be lowermost in the mold. This is for the reason that with such arrangement the metal constituting the flange, and the portion of the felly adjacent the flange, comes first to rest in the mold, and the remainder of the casting metal does not substantially disturb the metal forming this region of the wheel. If the mold arrangement were reversed, molten metal flowing past the chill into position to form the hub and disk of the wheel, and the inner portion of the felly, would heat the chill, and would also tend to heat such skin of casting metal as might congeal thereagainst in forming the tread and flange of the wheel.

I have found moreover that a wheel comprising a disk positioned at the outer edge of the felly, and chiefly outwardly beyond the rail-contacting portion of the tread serves, when a wheel is cast as above described, to lessen stresses to such extent that such wheels need not be taken to a soaking pit after casting. This is for the reason that the flange and outer portion of the felly will solidify and shrink in advance of any other portion of the wheel. With this metal already solidified, the mass of metal remaining molten consists of the hub, which acts as a reservoir of heat, the disk, and the portion of the wheel felly in direct contact with the disk and in communication with the hub through the disk. As there is a free condition of heat exchange in these regions after substantial solidification of the remaining felly portion of the wheel, the inner portion of the felly, in contact with the disk throughout the entire circumference of the wheel, may follow in its shrinkage the shrinkage of the disk and hub closely enough to prevent setting up stresses sufficiently severe to necessitate soaking the wheel after casting. For this reason a wheel of this conformation does not suffer loss in the degree or depth of tread hardness by an annealing operation subsequent to its casting.

In order to increase this effect, a chill of the form shown in Figure IV may be employed. This chill 6a has a region 6b of greatest thickness and heat capacity to lie against the region of the tread adjacent the flange of the wheel, and is tapered to provide a region 6c of lesser thickness and heat capacity adjacent the outer edge of the tread.

I have made a number of comparative hardness tests on my wheels and other chilled mine car wheels of standard form made in accordance with standard foundry practice. I have found that, by avoiding annealing in the soaking pit, the Brinell hardness in the highly chilled region of my wheel tread is from 25 to 40 points higher than the hardest regions (the regions between spokes) of tread in all the other wheels. The wheels used for these tests have been of

iron substantially identical with that composing my test wheels.

The extreme hardness difference taken on my tread at any circumferential point adjacent the flange and at the least hardened regions of the compared wheels (the tread regions diametrically outward of the spokes) is from 75 to 100 points Brinell. This latter instance is due not only to the avoidance of intentionally annealing in the soaking pit, but also to the mold effect above described in which heat flow outwardly to the felly is avoided in a selected transverse region of the tread.

It may be noted that there is a direct relation, in a section of substantial thickness, between the depth of chilled metal and the surface hardness. I obtain in the most highly chilled region of my wheel tread, a hardness of 514 to 520 points Brinell.

It may be noted that the depth of chilled metal in the felly of the wheel may be apportioned transversely of the tread by changes in the radius in the inner face of the disk 3 where it joins the felly of the wheel. That is, a greater or lesser transverse region of the felly may be in direct heat communication with the wheel hub by varying this radius. The design of the wheel may thus be varied within limits for different purposes in which the wheels are to be used, and variations in the tread width of the wheel.

There is, further, a positive advantage in the fact that the chill effect is minimized at the junction of the disk and felly. This is due to the fact that regions of cast iron retaining combined carbon, as by the effect of the chill, possess less strength. In my wheel the strength of the metal is greatest where strength is required, as also the hardness is greatest where hardness is requisite.

The various advantages of my wheel result from an intentional conformation of a cast wheel such that full advantage is taken of the use of a chill in modifying the qualities of the casting.

While a wheel of my novel form is peculiarly adapted for use on mine cars, it is to be understood that its advantages are also of value for cars of various types as used in industrial plants.

I claim as my invention:

1. A wheel for mine and industrial cars made as an integral casting and comprising a hub, a felly of substantially uniform mass throughout its circumferential extent, a disk interconnecting the hub and felly; the disk being positioned adjacent the outer edge of the felly and in the main outwardly beyond the inner rail-contacting region of the felly, the disk in its connection with the felly providing the entire area of contact and connection with the felly by the wheel elements lying radially inward of the felly, and reinforcing ribs extending between the hub and the disk, said wheel having a chilled tread comprised by the

felly and which tread has its depth of chill approximately uniform circumferentially of the felly and greater in the rail contacting region of the tread transversely beyond the region of disk contact with the felly.

2. A cast wheel for mine and industrial cars having a hub, a flanged felly, and connecting means therebetween integral with the hub and the felly, a chilled tread comprised by the felly and having a depth of chill approximately uniform circumferentially of the tread in the region adjacent the flange of the felly, said felly having no volume of metal extending radially inward of the felly in the region adjacent the flange of the felly, as a result of which a circumferentially uniform chill hardness in excess of five hundred on the Brinell hardness scale is attainable in that region, and reinforcing ribs extending between the hub and the means interconnecting the hub and felly out of contact with the region of the felly adjacent the flange of the felly.

3. A wheel for mine and industrial cars made as an integral casting and comprising a hub, a felly of substantially uniform mass throughout its circumferential extent, a disk interconnecting the hub and felly; the disk being positioned adjacent the outer edge of the felly and in the main outwardly beyond the inner rail-contacting region of the felly, the disk in its connection with the felly providing the entire area of contact and connection with the felly by the wheel elements lying radially inward of the felly, and at least one mass of reinforcing metal strengthening the junction between the hub and the disk, said wheel having a chilled tread comprised by the felly and which tread has its depth of chill approximately uniform circumferentially of the felly and greater in the rail contacting region of the tread transversely beyond the region of disk contact with the felly.

4. A cast wheel for mine and industrial cars having a hub, a flanged felly, and connecting means therebetween integral with the hub and the felly, a chilled tread comprised by the felly and having a depth of chill approximately uniform circumferentially of the tread in the region adjacent the flange of the felly, said felly having no volume of metal extending radially inward of the felly in the region adjacent the flange of the felly, as a result of which a circumferentially uniform chill hardness in excess of five hundred on the Brinell hardness scale is obtainable in that region, and at least one mass of reinforcing metal strengthening the junction between the hub and the means interconnecting the hub and felly, said mass of reinforcing metal terminating out of contact with the region of the felly adjacent the flange of the felly.

ARTHUR L. LEE.