

**July 26, 1949.**

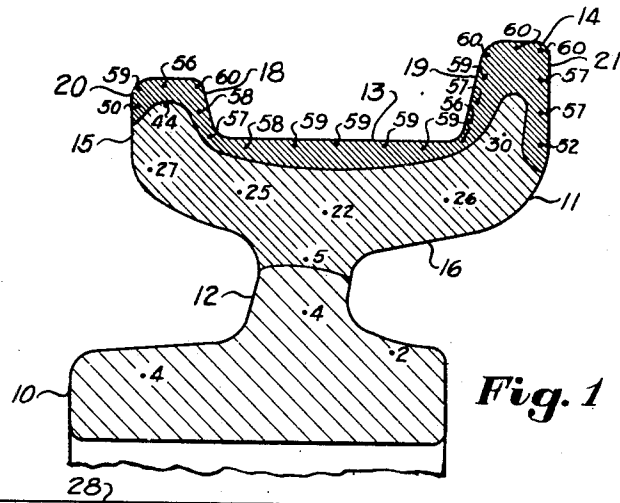
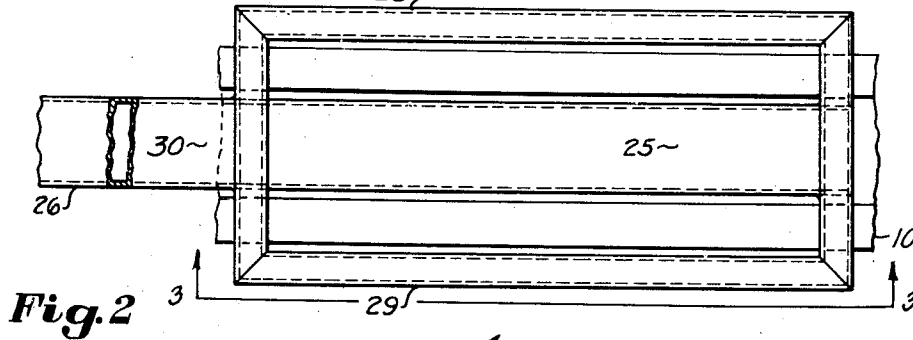
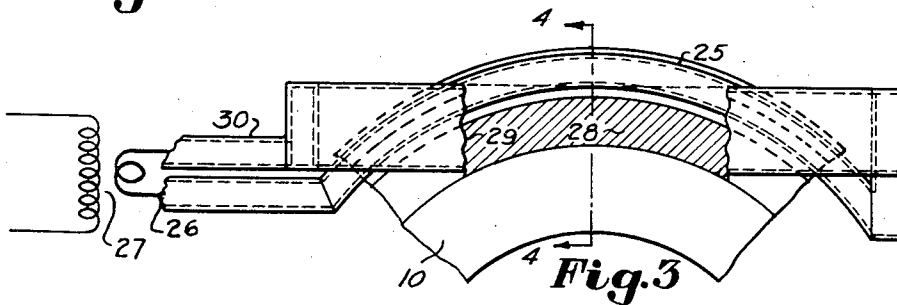
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**2,477,029**

# MEANS FOR INDUCTIVELY HEATING FLANGED ARTICLES

Filed Aug. 26, 1943

2 Sheets-Sheet 1



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July 26, 1949.

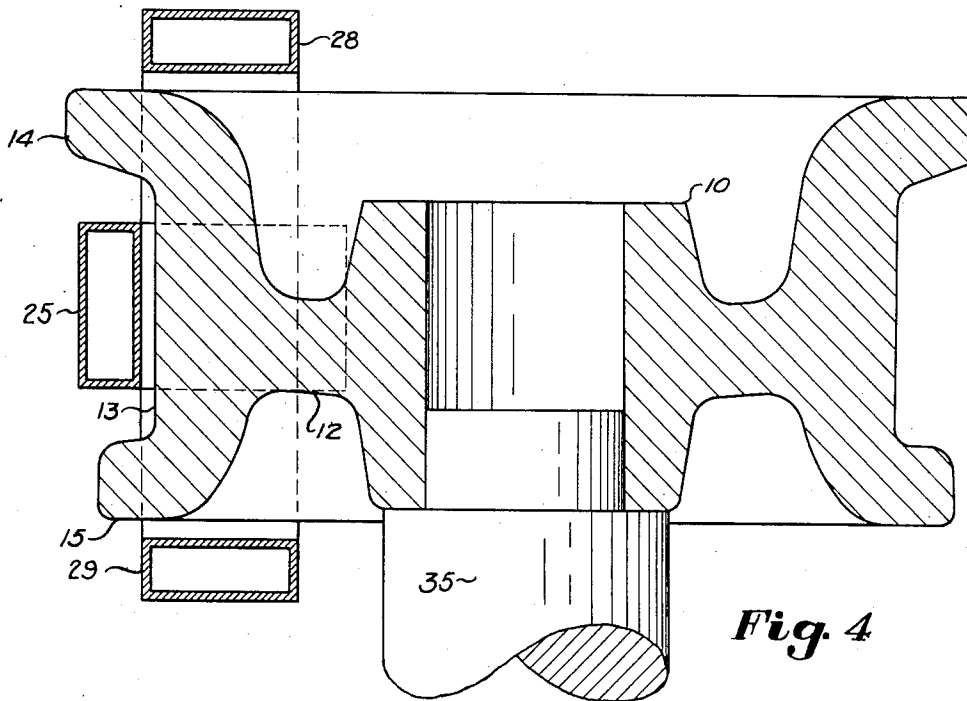
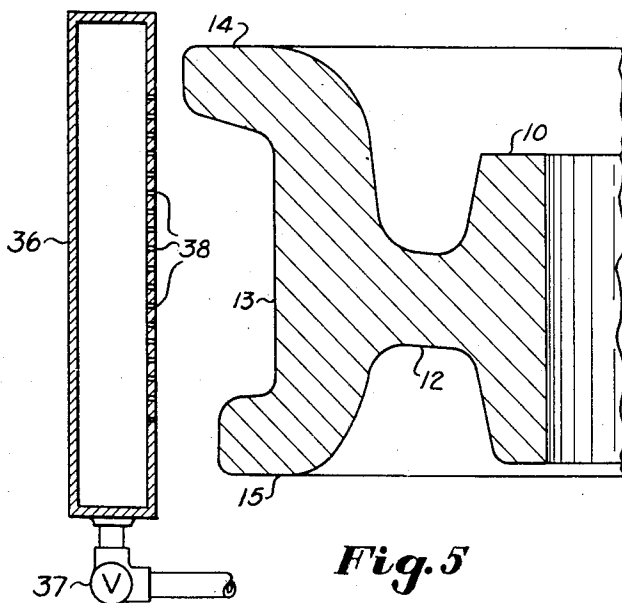
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MEANS FOR INDUCTIVELY HEATING FLANGED ARTICLES

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2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

2,477,029

MEANS FOR INDUCTIVELY HEATING  
FLANGED ARTICLESAlden O. Wood, Parma, Ohio, assignor to The  
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corporation of Ohio

Application August 26, 1943, Serial No. 500,143

6 Claims. (Cl. 219—13)

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The present invention is an improvement on the methods and apparatus shown and described in my copending applications Serial Nos. 475,833 now Patent No. 2,419,619 issued April 29, 1947 and 476,989 now Patent No. 2,428,303 issued September 30, 1947, filed February 13, 1943 and February 24, 1943 respectively, relates to dual inductive heat treating and is directed chiefly to the hardening of the rim portions of double flanged wheels and similar articles. Heretofore in the manufacture of wheels of this type it has been customary to make the wheels in the form of ferrous castings or rolled forgings. Since these wheels usually run on hard steel rails and carry heavy loads, it is necessary that the treads possess a high degree of strength and be resistant to the kneading action imposed on the treads and which, when the rim is not made of the correct material properly treated, results in the so-called "shelling" off of surface portions of the tread. Further, one or both flanges of the wheel which serve as means for guiding the wheel along the rail are subject to severe frictional wear and therefore must be hard and possess correct metallurgical structure.

Accordingly, it has been an object of this invention to provide apparatus adapted to harden all wearing surfaces at the rim of such double flanged wheel or similar article. Another object has been to provide means for accomplishing such hardening uniformly. A further object has been to provide apparatus adapted to heat various parts of the rim portion to selected depths to attain correct depths of hardness. An additional object has been to provide means for quenching at the correct rate to attain the desired hardness. Another object has been to provide a method generally applicable to the hardening of such wheels or similar parts. The chief object, however, has been to provide the herein-after described wheel having tread and flange portions of desired form and hardness.

With the above and other objects in view which will become apparent from the following description and annexed drawings, the said invention then consists of the hereinafter described and illustrated product together with the method of producing it and the apparatus required for the practice of this method.

In said annexed drawings:

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Fig. 1 illustrates a typical wheel partly in section, the section showing the general distribution of hardened and otherwise improved metal.

Fig. 2 is a plan view of the heating inductor showing a fragmentary part of the wheel in heating position therein.

Fig. 3 is a side elevation partly in section of the inductor taken in the direction indicated at 3—3 of Fig. 2 and showing a fragment of the wheel inserted therein.

Fig. 4 is a section on an enlarged scale substantially as indicated at 4—4 of Fig. 3.

Fig. 5 is a fragmentary vertical section showing the quenching member in place relative to the wheel rim.

Referring now to the drawings, particularly Fig. 1, the wheel to be heat treated comprises the hub portion 10 and the rim portion indicated generally at 11 together with the web or plate portion 12. The rim portion comprises the cylindrical tread area 13, inner flange 14 and outer flange 15, the tread and flanges being supported by section 16 lying intermediately between the flanges and the plate. The different cross hatchings indicate three different sections of metal. The metal in all of the three sections is substantially the same chemically, but is different metallurgically, each of the three sections being such as to provide the characteristics desired in that section.

In my improved process the tread and flanges are heated to critical temperature and quenched to provide a hard tread area at 13 resistant to shelling which area extends out into and around the flanges 14 and 15 to provide hard zones along inner lateral flange surfaces at 18 and 19 resistant to frictional wear. The outer lateral surface zones of the flanges, as at 20 and 21, are provided with hardness substantially equal to that of the tread and inner flange surfaces to add strength and rigidity to the flanges. While the outer areas are being heated to critical temperature to be quenched for hardness, the intermediate section 16 is heated to a lesser degree, but sufficiently to add to its physical properties, this section being less hard than the tread and flanges but tougher and more resistant to shock than the hub at 10. All numerals applied to Fig. 1 other than numerals 10 to 20 inclusive as above designated, show the hardness of the metal on

the Rockwell C scale at the various points indicated by dots or periods to which these numerals are directed and collectively show the variations in this hardness.

To provide this wheel the apparatus herein-  
after described or its equivalent is required. This  
apparatus comprises the inductor shown in Figs.  
2-4 and the quenching apparatus of Fig. 5. The  
inductor as illustrated comprises the member 25  
connected at 26 to one terminal of the source  
27 of high frequency current and members 28  
and 29 comprising parallel branches of the re-  
turn circuit, these branches being joined to form  
one conductor 30 which in turn is connected to  
the other terminal of the high frequency source.  
Conductor 25 is curved to lie generally parallel  
to and in closely spaced relation with the cyl-  
indrical tread portion 13 of the wheel. Side con-  
ductors 28 and 29 may assume a variety of forms,  
either straight as shown or curved, to control  
the depth of the hardened zones particularly in  
the flanges as measured radially of the wheel.

While Fig. 4 shows all of the three conductors  
comprising the inductor as being of the same  
general size and form, these conductors are fre-  
quently different to provide correct distribution  
of heating current in tread and flanges. For  
instance, the conductor 25 lying along the tread  
is varied in width to correspond with the width  
of the tread and its form is often changed to  
control the distribution of heating, particularly  
in the fillet. Likewise the side conductors 28 and  
29 are varied in sectional form and in the inclina-  
tion of their sides to the axis of the wheel.

It will be obvious that heating current will be  
induced only in that part of the wheel which lies  
in the magnetic circuit of the inductors. There-  
fore, to heat the entire peripheral part of the  
wheel, the wheel must be rotated during the ap-  
plication of inducing current to the inductor.  
This is accomplished by supporting the wheel  
on the support 35 which is rotated by any con-  
venient means during the heat treating cycle.  
Usually it is desirable to rotate the wheel at  
the maximum rate consistent with the size and  
weight of the wheel to reduce to a minimum the  
interval during which any element of the rim  
is outside the heating field. Further, it is usually  
desirable to extend the inductor as far as con-  
venient peripherally along the rim to prolong as  
much as possible the arc through which heating  
occurs. To that end the central conductor 25  
is often extended through an arc of nearly 180°  
and side conductors 28 and 29 are curved to ex-  
tend in a direction generally parallel with this  
central conductor to not only avoid interfering  
with the hub of the wheel but to more effectively  
concentrate heating flux in the rim portion.

After heating has been completed quenching  
is accomplished by moving the inductor away  
from the wheel, usually by rotating the trans-  
former to which the terminals of the inductor  
are attached, the transformer being supported to  
turn on a vertical axis, and then lowering the  
cylindrical quenching shell 36 over the wheel.  
Quenching fluid is supplied at suitable pressure  
from supply valve 37 and is projected through  
a large number of orifices such as 38 onto the  
heated rim portions.

The different degrees of heating to provide the  
hard tread and flange sections shown by the close  
cross hatching, and the tough supporting metal  
indicated by the medium spaced cross hatching  
without disturbing the original heat treatment  
of the hub and inner portions of the plate in-

indicated by the coarse cross hatching are accom-  
plished by selecting current of the correct fre-  
quency and then regulating the power input and  
time intervals during which power is applied at  
the different rates. In some cases it is desirable  
to change the frequency, finishing the heating  
with current of a higher frequency than that  
used in the earlier stages of the heating.

Numerous modifications in the general ar-  
rangement of the apparatus will become apparent  
to those skilled in the art. For example, the  
lateral conductors in many cases are curved to  
lie substantially parallel with the central con-  
ductor. In some cases only one lateral conductor  
is used, particularly when only one flange and  
the tread are to be heated. When it is difficult  
to rotate the work, as when the wheel is very  
large or when the flange is a straight or curved  
projection on a fixed member other than a wheel,  
the conductors are both made to extend along  
the entire length of the flange, as for instance  
to extend around substantially the entire pe-  
riphery of the wheel when the flange is a part  
of a wheel as illustrated. In such installations  
the two conductors are not permanently joined  
as illustrated in the present figures, but are  
joined together when put in place on the wheel  
to complete the series circuit through them.  
Ordinarily the conductors are of tubular con-  
struction to provide means for the circulation  
of cooling fluid and to more economically carry  
high frequency current.

Other modes of applying the principle of my  
invention may be employed instead of the one  
explained, modifications being made in details  
of the product described as well as in the method  
of producing it and in the form of apparatus  
required for accomplishing the method explained,  
provided these modifications or their equivalents  
are defined by the following claims.

I, therefore, particularly point out and dis-  
tinctly claim as my invention:

1. An inductor for heating tread and flange  
parts of a rim portion of a wheel comprising an  
inner conductor member having a curved sur-  
face disposed to lie in parallel closely spaced re-  
lation with a generally cylindrical surface of the  
tread part, said conductor member having a  
lateral surface disposed to lie in closely spaced  
relation with an inner tread adjacent face of the  
flange, an outer conductor member disposed to  
lie generally parallel with an outer circular face  
of the wheel and to extend as a chord across the  
circular face, the circular face having a circum-  
ference defined by an outer periphery of the  
flange, a part of the chordal conductor member  
being disposed to pass close to a side of the flange  
and having an end adapted to extend beyond the  
outer periphery of the flange, a center part of the  
chordal conductor member being disposed to lie  
generally radially inward from the flange and  
having end adjacent parts disposed to lie opposite  
to parts of the flange and with intermediate parts  
varying generally in distance from the flange, the  
distance being a minimum substantially adjacent  
to an outer periphery of the wheel and a maxi-  
mum at a center part of the chordal conductor  
member to vary heating proximity of the flange  
with the chordal conductor member from a maxi-  
mum adjacent to its end to a minimum at its  
center, conducting means adapted to extend  
across a peripheral part of the flange to con-  
nect the end of the chordal conductor member  
extending beyond the flange to an end of the  
curved conductor member, and means for supply-

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ing inducing current to flow in series through the curved conductor member and chordal conductor member to heat simultaneously the cylindrical surface of the tread and inner and outer surface zones of the flange.

2. In apparatus for heating tread and flange parts of a rim portion of a wheel, the wheel having a rim supporting plate, an inductor comprising an inner conductor member having a curved surface disposed to lie in parallel closely spaced relation with a generally cylindrical surface of the tread part of the wheel, said conductor member having a lateral surface disposed to lie in closely spaced relation with an inner tread adjacent face of the flange part, an outer conductor member disposed to lie generally parallel with an outer circular face of the wheel and to extend as a chord across the circular face, the circular face having a circumference defined by an outer periphery of the flange, the chordal conductor member having a substantially flat side disposed to present a relatively flat surface to lie adjacent to the wheel, the flat side having an outer edge which at its center is disposed to lie in current inducing proximity with an inner peripheral part of the flange, an inner edge of the flat side of the chordal conductor member being disposed to bridge a space adjacent to the flange and to lie relatively remote from the flange and from a plate part of the wheel, an end of the chordal conductor member being adapted to extend beyond outer peripheral parts of the flange, a conductor connecting the end of the chordal conductor member to an end of the curved conductor member, and means for supplying inducing current to flow in series through the curved conductor member and chordal conductor member to simultaneously heat the flange and the cylindrical surface of the tread.

3. In apparatus for heating tread and flanges of a double flange wheel, an inductor comprising a generally hollow central conductor adapted to lie between the flanges and two outer conductors adapted to lie along opposite circular faces of the wheel and outside of the flanges, the central conductor being of curved form to lie in substantially parallel relation with the tread of the wheel, the outer conductors lying generally parallel with each other and with a central plane of the center conductor and extending generally as chords across a part of the curved central conductor, a transverse conductor joining an end of one outer conductor to an opposite end of the other outer conductor and being disposed to lie radially beyond outer peripheries of the flanges and serving as means for joining the outer conductors to the center conductor, and means for supplying inducing current to flow in series through the center conductor and outer conductors, the outer conductors being electrically in parallel.

4. An inductor for heating tread and flange parts of a rim portion of a metallic wheel comprising an inner conductor having a curved surface disposed to lie in parallel closely spaced relation with a generally cylindrical surface of the tread part, said inner conductor having a lateral surface disposed to lie in closely spaced relation with an inner tread-adjacent face of the flange, an outer conductor disposed to lie generally parallel with an outer circular face of the wheel and to extend across the circular face, the circular face having a circumference defined by an outer periphery of the flange, a part of the outer conductor being disposed to pass close to a side of

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the flange and having an end adapted to extend beyond the outer periphery of the flange, a central part of the outer conductor being disposed to lie generally radially inward from the flange and having end parts disposed to lie opposite parts of the flange and with intermediate parts varying generally in distance from the flange, the distance being a minimum substantially adjacent to an outer periphery of the wheel and a maximum at a central part of the outer conductor to vary heating proximity of the flange with the outer conductor from a maximum adjacent to its ends to a minimum at its center, conducting means adapted to extend across a peripheral part of the flange to connect the end of the outer conductor extending beyond the flange to an end of the inner conductor, and means for supplying inducing current to flow in series through the inner and the outer conductors to heat simultaneously the cylindrical surface of the tread and inner and outer surface zones of the flange.

5. An inductor for heating tread and flange parts of a rim portion of a metallic wheel comprising an inner generally curved conductor having a curved surface disposed to lie in parallel closely spaced relation with a generally cylindrical surface of the tread part, said inner conductor having a lateral surface disposed to lie in closely spaced relation with an inner tread-adjacent face of the flange, an outer conductor disposed to lie generally parallel with an outer circular face of the wheel and to extend across the circular face, the circular face having a circumference defined by an outer periphery of the flange, a part of the outer conductor being disposed to pass close to a side of the flange and having an end adapted to extend beyond the outer periphery of the flange, the outer conductor lying generally along a chord subtending an arc of the inner conductor, a conductor joining the extending end of the outer conductor to an end of the inner conductor to connect said conductors in series, and means for supplying inducing current to flow in series through said conductors to heat simultaneously a surface zone of the tread and inner and outer surface zones of the flange.

6. Apparatus for induction heating of the rim and flange of a flanged type roller or the like which comprises a curved induction element arranged for disposal adjacent the rim and at one side of the flange during rotation of the roller, and another induction element cooperating with the first element to produce a heat inducing field and disposed at the opposite side of the flange on a line intersecting the arc of the first element.

ALDEN O. WOOD.

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