

April 21, 1942.

F. S. DENNEEN ET AL

2,280,064

INDUCTIVE HEATING APPARATUS

Filed Nov. 10, 1938

2 Sheets-Sheet 1

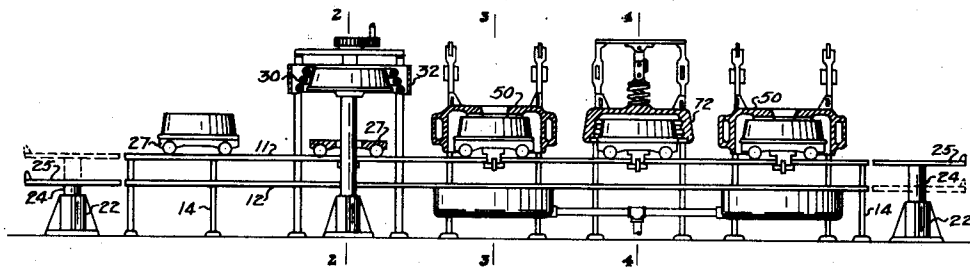


Fig. 1

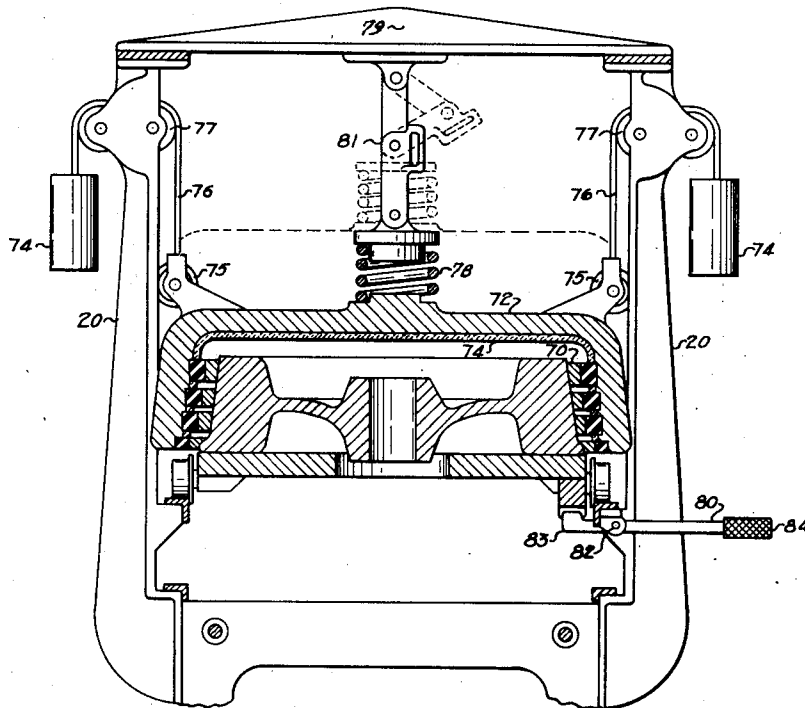


Fig. 4

INVENTORS
William C. Dunn and
Francis S. Denneen
BY *Ray, Oberlin & Ray*
ATTORNEYS.

April 21, 1942.

F. S. DENNEEN ET AL

2,280,064

INDUCTIVE HEATING APPARATUS

Filed Nov. 10, 1938

2 Sheets-Sheet 2

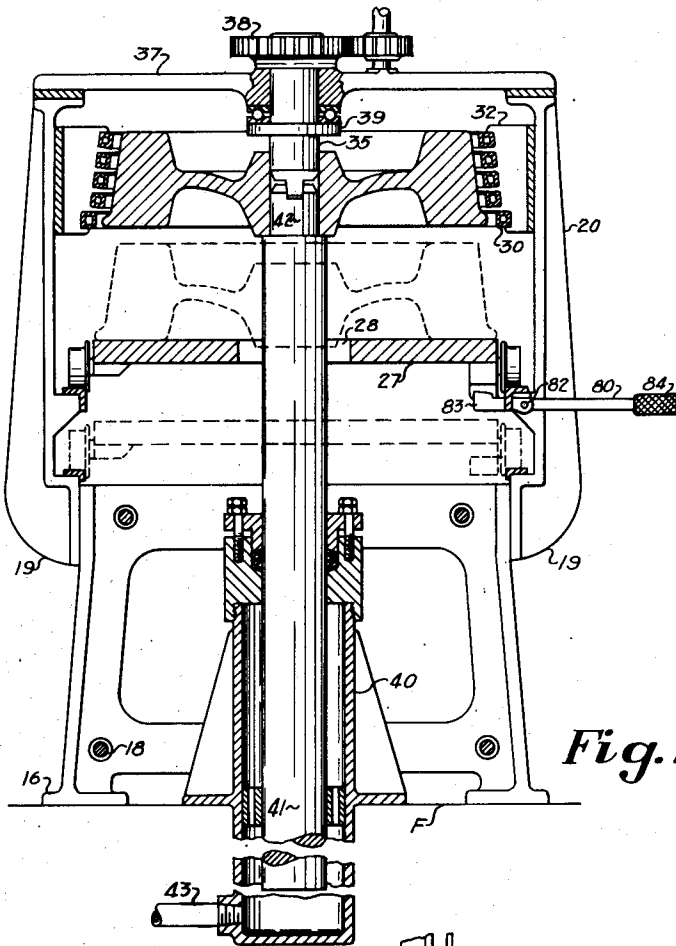


Fig. 2

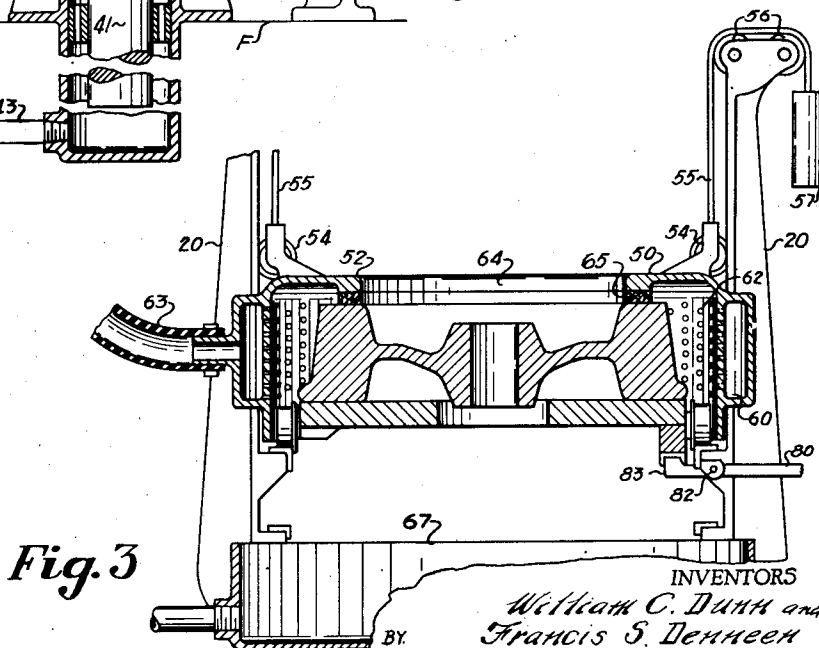


Fig. 3

INVENTORS

William C. Dunn and
Francis S. Denneen
By, Oberlin & Day
ATTORNEYS,

UNITED STATES PATENT OFFICE

2,280,064

INDUCTIVE HEATING APPARATUS

Francis S. Denneen, Cleveland, and William C. Dunn, Shaker Heights, Ohio, assignors to The Ohio Crankshaft Company, Cleveland, Ohio, a corporation of Ohio

Application November 10, 1938, Serial No. 239,811

9 Claims. (Cl. 219—13)

This invention relates to conveyor equipment for rapidly and economically handling car wheels and the like and is particularly directed to a conveyor system used during the hardening of railway car wheels.

Car wheels are required in large quantities and accurate and rapid means for handling and transporting the wheels during the heat treating operations is necessary to economically obtain the desired results. As the wheels are heavy, each weighing several hundred pounds, power means for lifting and transporting them is desirable. To secure uniformity of product the hardening steps for each wheel of a series must be substantially identical and this is partially attained by eliminating the human factor as much as possible during handling.

The general object of the present invention has been to provide apparatus, including handling equipment, to effectively heat and quench a wheel to permit production in quantity. Other objects of the invention will become apparent from the following description and the appended drawings.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims; the annexed drawings and the following description setting forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings—

Fig. 1 is a longitudinal section through our improved handling equipment.

Figs. 2, 3 and 4 are enlarged sections showing a wheel in place at various stations and are indicated by lines 2—2, 3—3 and 4—4, respectively, of Fig. 1.

In general our apparatus comprises a cooperating unit consisting of a conveyor system serving a primary heating station, a primary quenching station, a secondary heating station and a secondary quenching station. We find it desirable to inductively heat a wheel at the first station to the proper hardening temperature and thereafter quench the same at the primary quenching station. In order to draw the temper, a reheat of the wheel is effected by contact resistance heating means at the second heating station and this in turn is followed by subjecting the wheel to quench at the second quenching station.

A double trackway is provided on a suitable foundation with a hydraulic lift at each end to

facilitate the handling of small cars or dollies to transport the wheel through the successive stations. At the end of the sequence, after the wheel has been removed from the dolly the latter is lowered by the lift to a lower trackway and returned to its initial position to receive another wheel and follow the same sequence.

The conveyor system includes mechanism for moving the wheels transversely of the trackways into active position with parts of the unit effecting the heat treatment. At one of the heating stations and the quenching stations the units themselves are moved into cooperating relation with a wheel remaining on a dolly.

It will be apparent that our invention does not, for all uses, require the four stations shown and hereafter described but that various types of heat treatment will require the use of less than the entire number of heating and quenching units. As an extreme, a wheel could be heated and air cooled and thus employ only a single induction or resistance heating unit.

Referring now to Fig. 1, we provide a double trackway formed with an upper track 11 and a lower track 12, each carried by a series of supporting frames 14. These frames, as shown in Fig. 2, are preferably castings of O-shape and on the bottom are formed with flanges 16 for bolting the same to a suitable foundation F. Brace rods 18 pass transversely through the frames and are rigidly secured thereto to reinforce the entire unit in a longitudinal direction.

The trackways are secured to ledges of arms 19 which in turn are bolted to the upper portions of the frames 14 and on either side thereof. As shown in Figs. 2, 3 and 4, at their upper ends certain of the arms are variously extended as at 20 and are shaped to support additional elements of the system hereafter described. At each end of the system the arms 19 merely support the tracks and do not extend above the upper trackway.

Pneumatic lifts, as shown in Fig. 1, are provided at each end of the trackways to transfer a car or dolly from one trackway to the other. These lifts each comprise a cylinder 22 secured to the foundation and carrying a piston 24, which in turn supports a table 25. The pneumatic mechanism by which the table is raised and lowered is of a type well known and is not further described.

The cars or dollies 27, movable along the trackways, are, as shown in Figs. 1 and 2, rectangular platforms with a large central opening 28 and are supported at the four corners on flanged

wheels engaging the trackway. The opening 28 in each dolly is, as hereafter described, to permit the wheel handling equipment to pass through the floor of the dolly and raise a wheel thereon.

The system comprises four heat treating stations. The first of these stations inductively heats the wheel and the second quenches the heated wheel after it has been brought to hardening temperature. If it is desired to reheat the wheel the same is then passed to the third station and is thereafter quenched or cooled by water forcibly sprayed thereagainst at the fourth station. The relatively large volume of metal heated in the handling of car wheels permits transporting a wheel from a heating station to a quenching station without substantial loss of heat and resultant temperature drop.

The first of the heat treating stations, as shown in Figs. 1 and 2, comprises a coil 30 formed of a hollow tubing wound, as indicated in Fig. 2, to conform to the contour of a wheel to be inductively heated therein. The coil is supported in brackets 32, which in turn are secured to the upper end of four similar extensions 20 of arms 19, bolted as heretofore described to opposite sides of two frames 14.

To raise the temperature of the flange and tread portion of the wheel, periodically varying current from any suitable source is supplied to the coil and the magnetic field created by the passage of current through the coil inductively heats the adjacent portion of the car wheel. Coolant is circulated through the hollow tubing to prevent an excess temperature rise in the inductor member.

Slow rotation of a wheel located within the confines of the coil 30 is desirable to insure uniform heating of the entire periphery. To this end a stub shaft 35 is rotatably carried in a central bearing in a top plate 37 supported on the four extensions 20. The shaft carries a gear 38, which is driven from a pinion connected to any suitable source of power. The shaft is retained against up and down movement by a thrust bearing between the under side of the members 37 and a shoulder 39 on the shaft and by the lower face of the gear 38 respectively.

A wheel located on the trackway 11 beneath the mechanism just described is raised from the dolly and lifted into heating position. To accomplish this we provide a hydraulic cylinder 40 with a piston 41 which is formed at its upper end with a reduced shank 42. This shank engages within the axle hole of the wheel and supports the wheel weight on the shoulder formed where the shank and piston merge. Oil is supplied to the cylinder through a pipe 43 from any suitable source.

As the piston 41 moves upwardly under the influence of pressure within the cylinder it passes through the opening 28 in the platform of the dolly lying thereabove and engages the axle hole of the wheel on the dolly to raise the same from the dotted line position of Fig. 2 to the solid line position. This places the wheel within the field of the coil 30 and at the same time establishes its slow rotation by reason of a downwardly extending rib on the rotating shaft 35, which engages a corresponding recess in the shank 42 to rotate the cylinder and wheel.

After the wheel has been heated to the desired temperature the pressure in the cylinder 40 is released and the wheel is lowered back onto the dolly 27, from which it was first raised. The piston then drops down to a position below the

level of the lower track and the wheel and dolly are moved along the upper track to a position underlying the quenching bell 50, shown in Figs. 1 and 3.

The quenching bell comprises a large casting 52 which may be lowered to surround the heated wheel. The bell is guided for vertical movement along a trackway formed by the four extensions 20 shown in Fig. 3, each of which includes a track traversed by a roller 54 carried by the bell. Cables 55 lead upwardly from the bell and over pulleys 56 at the top of each extension and thence to counterweights 57, by which the weight of the bell is balanced to insure its easy raising and lowering.

Quench water is forcibly projected against the wheel from an integral annular chamber 60 encircling the bell and provided on the inner or wheel adjacent side with a series of orifices 62, pointing, as shown in Fig. 3 toward a wheel surrounded by the bell. Coolant is forced to the chamber and through the orifices against the wheel from a flexible hose 63, which in turn is connected with the quench supply reservoir.

The upper face of the bell 52 is open as at 64 to reduce weight and simplify construction. A heat resistant sealing ring 65 is carried by the bell adjacent the opening 64 to lie against the heated wheel and prevent excessive spraying outwardly through opening 64 of the steam and agitated quenching water. The spent quench water drops downwardly into a tank 67 which, as shown in Figs. 1 and 3, is bolted to the corresponding frames 14 below the level of the tracks.

It is frequently desirable to reheat a wheel just cooled and this may be accomplished in that part of the system shown in Fig. 4 comprising the third station. Here the wheel is heated by resistance heating rings which bear against the flange and tread portions and, by the electrical resistance of the wheel to the direct passage of current therethrough the wheel tread is heated to the desired temperature. We provide four resistance rings, as shown in Fig. 4 and as indicated at 70, which are carried on, and insulated from, the inner side wall of a bell 72, which bell is coated with heat resistant insulation 74 and is slidable vertically in the corresponding frame extension 20 along tracks cooperating with rollers 75 carried by the bell. Cables 76 interconnect the bell and the counterweights 74 and pass over pulleys 77 at the top of the extensions.

The resistance rings are resiliently urged against the portion of the wheel to be heated to insure efficient electrical contact therebetween. Thus, as shown in Fig. 4, there is provided a heavy spring 78, which at one end bears against the bell and at the other against a toggle mechanism 81, which in turn is pivotally carried by a frame 79 spanning the extensions 20 adjacent the third station. As the toggle is straightened from the dotted line position of Fig. 4 the spring 78 forces the bell 72 downwardly and the taper of the wheel contacts the rings 70 and allows the heating current to flow into the wheel.

After the wheel has been heated in the heating station of Fig. 4 the bell is raised and the wheel is passed on its dolly to a second quenching station, shown in Fig. 1, and which is identical in all respects with the quenching station already described and therefore not further discussed.

After a wheel has been completely heat treated by one or all of the stations just described, it and its supporting dolly are moved on to the right-hand table 25, from which point the wheel may be lifted and removed from the system. The dolly is then lowered on the table 25 to the lower trackway 12 and returned to the left-hand platform by which it is raised back on to the track 11 in position to receive an untreated wheel.

To insure registration of a dolly and its supported wheel with the heat treating equipment at a station, it is necessary to have a stop at each of the stations. This, as best shown in Figs. 2, 3 and 4, comprises an arm 80 pivoted at 82 beneath the track 11 and provided at its inner end with a heavy tooth 83. The adjacent side of each dolly carries a notch which may be engaged by the tooth and on each side of the notch a cam surface which will engage and cam the tooth 83 downwardly along its surface until the tooth, due to the weight of the handle portion 84 rises and engages the notch in the dolly and stops its movement; thus registering the wheel thereon with the apparatus of the station at which it is stopped. After treatment at the said station the handle 84 is raised and this releases the dolly for further movement along the track.

From the foregoing description it will be apparent that we have invented a handling equipment which may be used in conjunction with the hardening operations as especially directed to heavy articles, such as car wheels. It will also be apparent that the various stations may be interchanged with the others, depending upon the characteristics desired in the ultimate product.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the structure herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

We therefore particularly point out and distinctly claim as our invention:

1. In inductive heating apparatus of the class described adapted to handle articles with a central bore, a foundation, an induction heating station, an induction coil at said station adapted to surround in closely spaced relation a part of an article to be heated, a fitting adapted to be rotated at said station, a support for an article to be heated at said station and means to move said support to engage the same with said fitting and rotate said article within the confines of said coil at said heating station.

2. In inductive heating apparatus of the class described adapted to handle articles with a central bore, a foundation, an induction heating station, an induction coil at said station adapted to surround in closely spaced relation a part of the article to be heated, a fitting adapted to be rotated at said station, a support for an article to be heated at said station, means to move said support to engage the same with said fitting and rotate said article within the confines of said coil at said heating station and a thrust bearing to receive the thrust of said support moving means.

3. In apparatus for inductively heating an annular surface of an article, an inductor member shaped to generally conform to the article surface to be heated, a reciprocating column mounted for movement toward and from said inductor along the axis of the inductor, means to raise

and lower said column, a normally rotating member in axial alignment with said column, a pair of clutch elements, the one on said column and the other on said fitting to engage said column and drive the same from said fitting in one position of said column and a support on said column for an article to be received in said inductor to be heated thereby.

4. In apparatus for inductively heating an annular surface of an article provided with a central bore, an inductor member adapted to generally conform to and embrace the article surface to be heated, a reciprocating column mounted for movement toward and from said inductor along the axis of the inductor, means to raise and lower said column, a normally rotating member in axial alignment with said column, a pair of clutch elements, the one on said column and the other on said rotating member to engage said column and drive the same from said rotating member in one position of said column and a support on said column for engaging with the bore of an article to be received in said inductor to be heated thereby.

5. In apparatus for inductively heating the outer annular face of disk-like articles provided with a central bore, an inductor member shaped to generally conform to and embrace the article surface to be heated, a reciprocating column mounted for movement toward and from said inductor along the axis of the inductor, means to raise and lower said column, a normally rotating member in axial alignment with said column, a pair of clutch elements, the one on said column and the other on said rotating member to engage said column and drive the same from said rotating member in one position of said column, and a support on said column to receive an article with the article bore aligned with the axis of said inductor to be heated thereby.

6. In apparatus of the class described for inductively heating to a shallow depth only the track contacting portion of a car wheel and the like, a foundation, an inductor supported thereby and shaped to substantially conform to the contour of said portion and adapted to lie in spaced inductive heating relationship therewith, a conveyor supported by said foundation below said inductor, said conveyor having an opening therethrough adapted for registration with an axial bore of said wheel, means supported by said foundation below said conveyor and adapted to pass through said opening, engage said bore and the rim thereof and raise said wheel off of said conveyor and into said relationship.

7. In apparatus of the class described for inductively heating to a shallow depth the track contacting portion of a car wheel and the like, a foundation, an inductor supported thereby shaped to substantially conform to the contour of said portion and adapted to lie in spaced inductive heating relationship therewith, a conveyor supported by said foundation below said inductor, said conveyor having an opening therethrough adapted for registration with an axial bore of said wheel, a shaft supported by said foundation coaxial with said inductor and adapted to project through said opening, engage said conveyor and the rim thereof and raise said wheel off of said conveyor and into said relationship and means for moving said shaft.

8. In apparatus of the class described for inductively heating to a shallow depth the track contacting portion of a car wheel and the like, a foundation, an inductor supported thereby

shaped to substantially conform to the contour of said portion and adapted to lie in spaced inductive heating relationship therewith, a conveyor supported by said foundation below said inductor, said conveyor having an opening therethrough adapted for registration with a shoulder of said wheel, a shaft supported by said foundation coaxial with said inductor and adapted to project through said opening, engage said wheel and the said shoulder thereof and raise said wheel off of said conveyor and into said heating relationship, means to stop said conveyor when it has moved far enough to position said opening between said shaft and said inductor and means for moving said shaft.

9. In inductive heating apparatus of the class

described adapted for inductively heating articles, a foundation, an induction heating station supported thereby, an induction coil at said station adapted to surround in closely spaced relation a part of said articles for heating the same, a rotatable member at said station adapted to be driven, a support for said article movable toward and from said member, clutch means interposed between said support and said rotatable member and operative on movement of said support to a position adjacent said member to engage said support and said member for rotating said support whereby said article may be rotated within the confines of said coil at said station.

WILLIAM C. DUNN.

FRANCIS S. DENNEEN.