Dec. 17, 1929. W. G. HILDORF 1,740,347

METHOD OF HARDENING ARTICLES

Filed Dec. 5, 1927 2 Sheets-Sheet 1

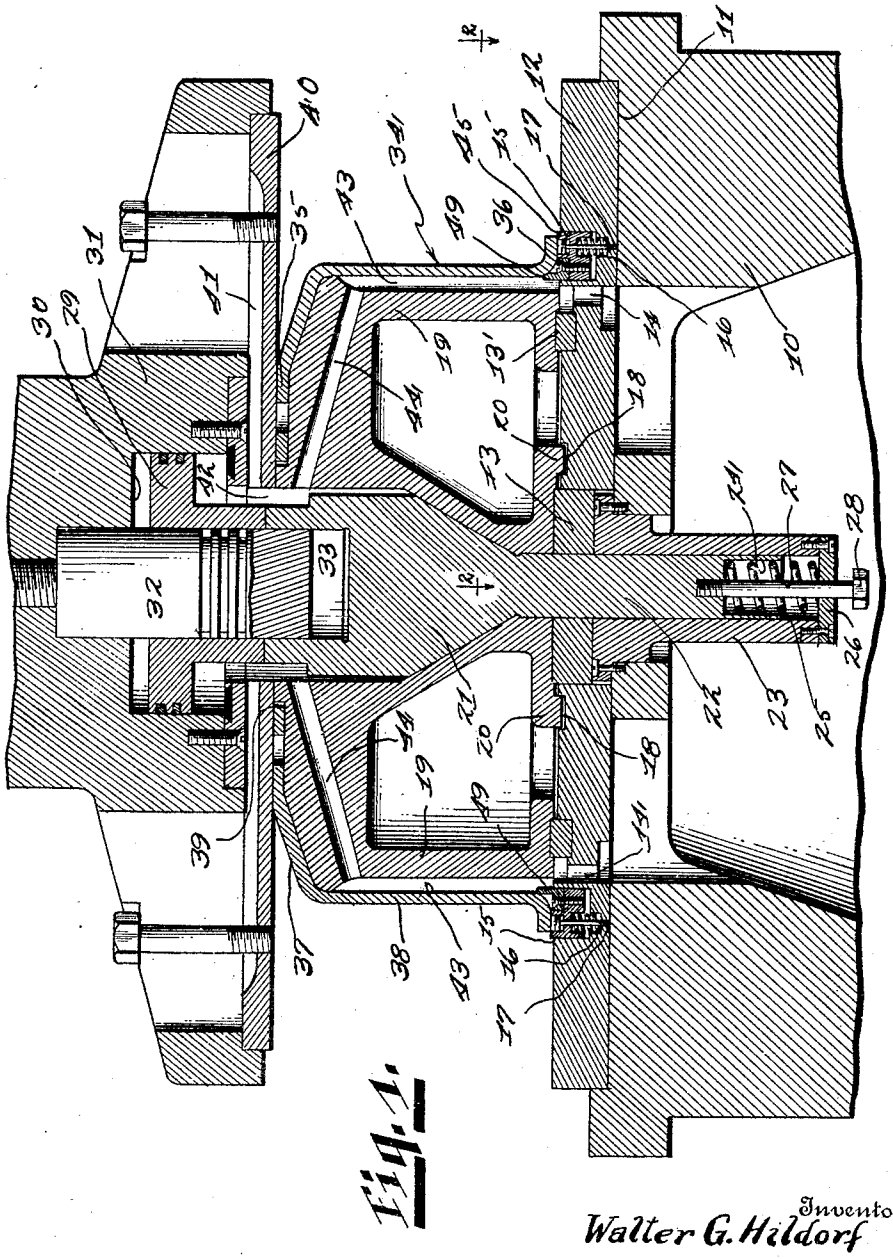


Fig. 1.

Inventor
Walter G. Hildorf

By Whittemore, Hulbert & Whittemore, Belknap
Attorneys

Dec. 17, 1929. W. G. HILDORF 1,740,347

METHOD OF HARDENING ARTICLES

Filed Dec. 5, 1927 2 Sheets-Sheet 2

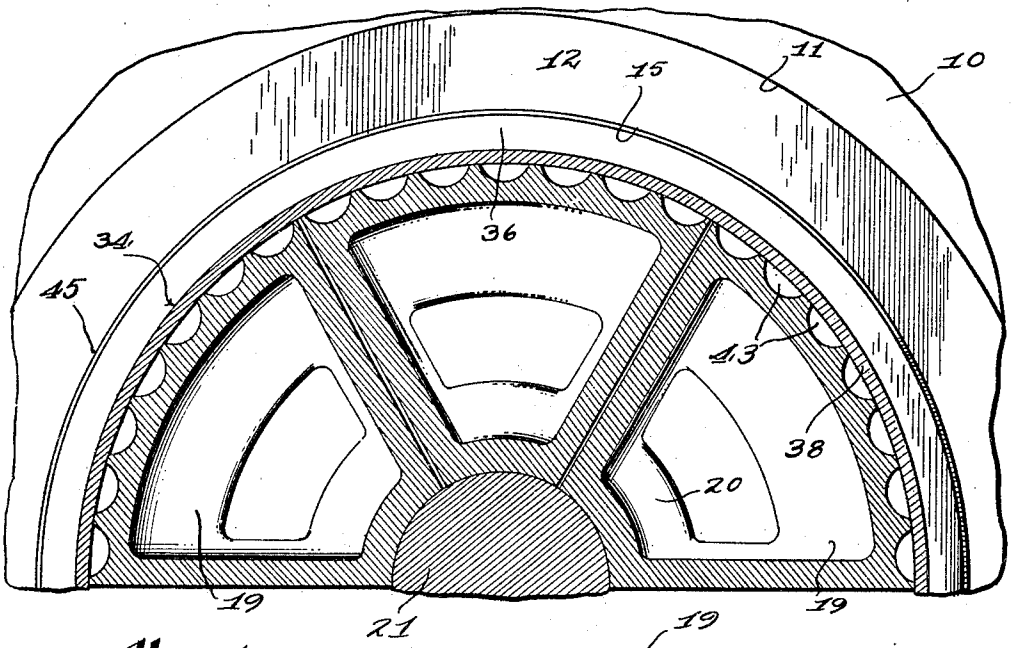


Fig. 2.

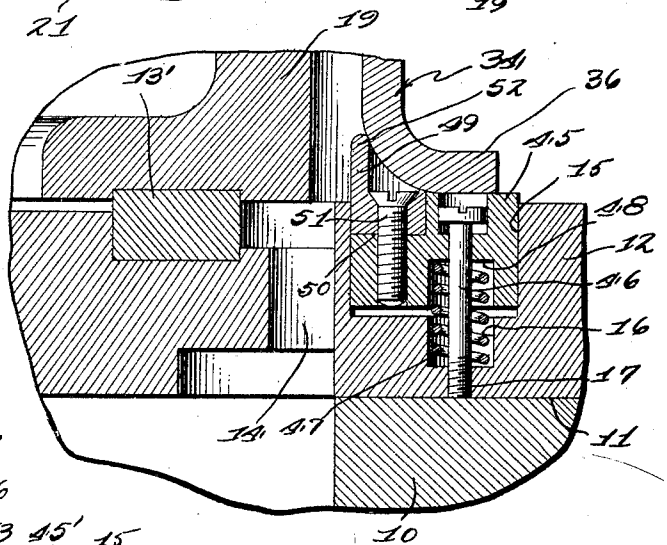


Fig. 3.

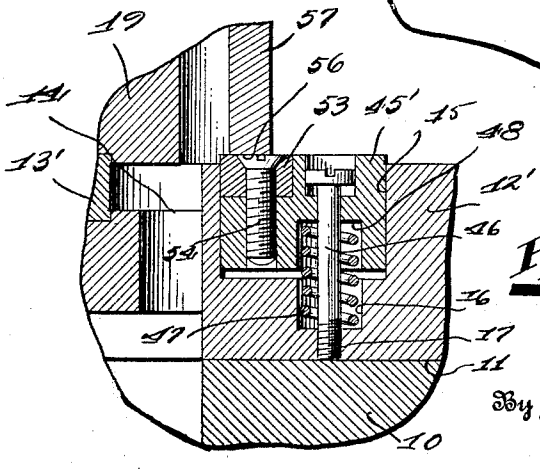


Fig. 4.

Inventor
Walter G. Hildorf

By Whittemore Hulbert & Whittemore Belknap
Attorneys

Patented Dec. 17, 1929 1,740,347

UNITED STATES PATENT OFFICE

WALTER G. HILDORF, OF LANSING, MICHIGAN, ASSIGNOR TO REO MOTOR CAR COMPANY, OF LANSING, MICHIGAN, A CORPORATION OF MICHIGAN

METHOD OF HARDENING ARTICLES

Application filed December 5, 1927. Serial No. 237,972.

This invention relates to a method and apparatus for use in the hardening of articles and has particular reference to a method and apparatus for treating articles with a fluid during the hardening operation.

This invention finds particular utility in the operation of quenching articles and has as an object to provide a method whereby one portion of the article may be chilled in advance of the other portion.

A further object of this invention is to provide a quenching apparatus having means for initially directing a quenching fluid into contact with one face of the article to be quenched, while maintaining the other face of the article to be quenched, free from contact with the quenching fluid.

A still further object of this invention is to provide a quenching apparatus having means for compensating for variations in the heights of the articles to be quenched, so that the apparatus will readily adapt itself to a number of different articles of various heights.

Another object of this invention is to provide a quenching apparatus having means for preventing contact of the quenching fluid with one portion of the article being quenched, whereby this portion of the article will retain its toughness and its ability to resist shocks.

Other objects and advantages of this invention will become apparent as the following description proceeds.

Broadly my method consists in clamping a portion of the article to be quenched between two members whereby the clamped portion of the article will be protected from contact with the quenching fluid and in subsequently lowering the clamped article into a bath of quenching fluid whereby the unclamped portion of the article may be treated with the quenching fluid. My method further includes the step of so directing the flow of the quenching fluid that one face of that portion of the article to be quenched will be treated with the quenching fluid in advance of the other face. This step is of particular importance since I have found when an attempt is made to simultaneously quench both faces of the article, extreme difficulty is experienced in that the quenching is often uneven and the article is distorted during shrinkage. This is particularly true where the article is flanged, since it is almost impossible to so control the quenching fluid as to simultaneously and evenly effect a contact of the quenching fluid with both faces of the article. However, by directing the quenching fluid so that one face of the article is quenched in advance of the other and by initially maintaining the quenching fluid free from contact with one face of the article, this difficulty is eliminated and the article is not distorted upon shrinkage.

My method finds particular utility in quenching brake drums formed of a steel of a high carbon content, this steel being rolled into sheets, then heated and pressed into drums which are subsequently quenched. I will therefore proceed to describe my method in connection with the quenching of a brake drum, but it is to be clearly understood that the description will be for the purpose of illustration only, and that the features of the inventive idea may be efficiently embodied in the method of quenching or treating with a fluid any article regardless of its character.

As brought out above, in the forming of the brake drum, the drum is preferably first rolled from a sheet of steel of a high carbon content. The drum is then heated and loosely mounted on an expansible form which has been expanded to the desired diameter of the finished drum. The web of the drum is then clamped between the upper portion of the expansible form and a suitable die, whereby this web portion is protected from contact with the quenching fluid and the drum is then lowered into a vat of quenching fluid.

Upon lowering the heated drum into the vat of quenching fluid the quenching fluid is caused to first contact with the inner periphery of the brake drum and is prevented from initially contacting with the outer periphery of the drum. After the inner periphery of the drum has been treated by the quenching fluid, and the drum has been set thereby, the quenching fluid is then permitted to contact with the outer periphery of the brake drum

to completely quench the drum. As brought out before, during this entire operation the web portion of the drum is maintained substantially free from contact with the quenching fluid so that after removal of the drum from the quenching fluid one portion of the drum will be extremely hard, while the other portion of the drum which has not been in contact with the quenching fluid will be extremely tough.

While various apparatuses may be provided for carrying out the method described above, I have found that this method may be conveniently and efficiently carried out on the apparatus disclosed in the accompanying drawings, wherein

Figure 1 is a central vertical sectional view through the apparatus,

Figure 2 is a fragmentary horizontal sectional view taken substantially on the plane indicated by the line 2—2 of Figure 1,

Figure 3 is an enlarged sectional view showing the details of construction of the means for preventing initial contact of the quenching fluid with the outer periphery of the brake drum and

Figure 4 is a view similar to Figure 3 of a slightly modified form of apparatus.

Referring now particularly to the drawings wherein like reference characters designate corresponding parts throughout all views of the same 10 designates a supporting member which may be in the form of a spider and which supports the lower die, and expansible form hereinafter to be described.

Mounted on the supporting member 10, in a centrally arranged depression 11, is a lower or supporting die 12. The lower die 12 is provided with a plurality of radially arranged fluid passages 14, and a relatively deep annular groove 15 which is provided at its base with a plurality of spaced sockets 16 communicating with threaded apertures 17. The upper face of the lower die is provided with a relatively wide but shallow groove 18 to receive the flanges of the segments of the expanding form hereinafter to be described and is further provided with the inserts 13 and 13′, which project above the upper face of the die to form bearing surfaces for the said segments.

Mounted on the inserts 13 and 13′ is an expansible form composed of a plurality of segmental die or form members 19, each of which is provided with a flange 20 adapted to be received in the groove 18 formed in the lower die 12. As clearly illustrated in Figure 1 of the drawing, the flanges 20 are of less thickness than the width of the grooves 18, whereby radial movement of the form members 19 is permitted.

The segmental die or form members 19 are adapted to be radially displaced by a pilot expander or ram 21, the latter being provided with a reduced extension 22 having a bearing in a bushing 23 carried by the supporting member 10. As clearly illustrated in Figure 1 of the drawing, the lower extremity of the extension 22 is provided with a socket 24 in which is mounted a spring 25 having one end bearing against the base of the socket and its other end bearing against a plate 26 carried by the lower end of the bushing 23. As will be readily apparent, the spring 25 tends to urge the pilot expander or ram upwardly to permit inward radial movement of the segmental die members 19. To limit upward movement of the ram 21, there is provided a bolt 27 threaded into the lower end of the extension 22. This bolt projects through the plate 26, being slidably received in an aperture arranged centrally of this plate and is adapted to receive at its lower extremity a threaded member or nut 28. It will be apparent that contact of the nut 28 with the plate 26 will limit upward movement of the ram 21.

For forcing the ram 21 downwardly against the tension of the spring 25, there is provided a piston 29, this piston being mounted for reciprocation in a suitable chamber 30 formed in an upper supporting member 31, which member may also be of a spider shape. For maintaining the piston expander 29 in alignment with the ram 21, there may be provided a centering pin or piston 32 which is carried by the upper supporting member and is adapted to be slidably received in a socket 33 formed in the upper face of the ram 21. The expander 29 may be actuated in any desired manner as by the admission of compressed air into the chamber 30 and the downward movement of the piston expander 29 forces the ram 21 downwardly against the tension of the spring 25 to expand the segmental form members 19. While it is immaterial what means may be provided for actuating the piston expander, it is essential that there be a definite relation between the force of the actuating means and the spring 25 so that the expansible form member 19 may be radially displaced only a predetermined desired amount. This is extremely important since the brake drum when located is of greater diameter than the ultimate diameter desired and is loosely mounted on the expansible form which has been previously adjusted to the desired inner diameter of the brake drum.

In Figure 1 of the drawing, I have shown a brake drum designated generally by the reference character 34. This brake drum is provided with the web portion 35, the lower flange 36, and may if desired be provided with the inclined portion 37 which extends between what might be termed the drum portion proper 38 of the brake drum and the web 35.

As clearly illustrated in Figure 1 of the drawings the brake drum 34 is adapted to be mounted on the segmental form members

19 each of which is provided with a cut away portion 39, which together form substantially a circumferential recess adapted to receive the web 35 of the brake drum. For clamping the web 35 of the brake drum in the recess 39, there is provided an upper die 40 which is carried by the upper support 31 and which is adapted to engage the web 35 of the brake drum when the upper support is moved toward the lower support 10 and lower die 12.

The upper die 40 is provided in its upper face with a plurality of radially extending grooves 41 which communicate at their inner ends with a central chamber 42 formed by the form members 19 and the upper die 40. The form members 19 are scalloped on their outer periphery as clearly illustrated in Figure 2 of the drawing, and these scallops together with the drum portion 38 of the brake drum form a plurality of fluid passages 43, which communicate at their lower ends with the fluid passages 14 formed in the lower die 12 and which communicate at their upper end with diagonally extending passages 44 formed in the upper portion of the form members 19 between the passages 43 and the central chamber 42. It will thus be seen that there is provided a continuous fluid passage from below the lower die 12 past the form members 19, through the upper portions of the form members 19 and out through the upper support 31.

In operation, with the brake drum clamped on the apparatus as illustrated in Figure 1 of the drawing, the complete apparatus is lowered into a bath of quenching fluid preferably oil. By virtue of the spider form of the lower support 10, the quenching fluid is permitted to flow upwardly through the fluid passages 14, 43 and 44 to the central chamber 42, from which it passes through the grooves 41 to the spider portion of the support 31, where it passes upwardly through the support 31, after which it may flow over the edges of said support and back down into the tank. The size of the lower support 10 and lower die 12 is such that when the apparatus is lowered into the vat of oil, pressure is exerted on the surface of the oil or quenching fluid by the lower support and lower die. Thus the quenching fluid is forced under pressure up through the passages aforesaid, in advance of the flow of the quenching fluid around the outer periphery of the lower die and form and therefore in advance of the contact of the quenching fluid with the outer periphery of the brake drum.

As brought out before, it is an object of this invention to assure contact of the quenching fluid with the interior of the brake drum in advance of the contact of the quenching fluid with the outer periphery of the brake drum, and to accomplish this result there is provided a bearing or supporting ring 45 on the lower die 12. This bearing or supporting ring 45 is mounted in the annular groove 15 in the lower die 12, being held in place by bolts 46, which pass loosely through the bearing ring 45 and which engage in the spaced threaded apertures 17 formed in the lower die. Surrounding the bolts 46 are springs 47, which bear at one end against the base of the sockets 16 formed in the lower die 12, and which bear at their other ends against the base of sockets 48 formed in the bearing ring 45. It will thus be apparent that the springs 46 tend to constantly urge the bearing ring 45 upwardly into contact with the brake drum 34 mounted in the apparatus. By virtue of the yieldable mounting of the bearing ring 45, this bearing ring will always be firmly pressed against the lower flange 36 of the brake drum to form a tight seal against this lower flange. Further, movement of the bearing ring 45 will permit the apparatus to be used with brake drums of different heights, since the bearing ring will immediately adapt itself to the height of the brake drum.

For forming a further seal with the lower edge of the brake drum 34, there is provided a guard ring 49 which is mounted in a recess 50 formed on the inner periphery of the bearing ring 45 and which is secured to the bearing ring by a plurality of spaced screws 51. This guard ring is provided with an upstanding flange 52 formed on its inner periphery, which flange may be curved to conform to the curve of the lower edge of the brake drum 34.

From the above, it will be obvious that the bearing ring 45 and guard ring 49 will form a tight seal between the flange 36 of the brake drum 34 and the lower die 12. Thus quenching fluid forced upwardly through the fluid passage 14, is prevented from passing to the outside of the brake drum and is forced upwardly through the passages 43 so as to contact initially with the inner periphery of the brake drum 34. The initial contact of the quenching fluid with the inner periphery of the brake drum tends to first set the brake drum and it is to be understood that upon the complete immersion of the apparatus in the bath of quenching fluid, the quenching fluid will contact with the outer periphery of the brake drum to entirely quench the same.

It is to be further noted that by virtue of the fact that the web 35 is clamped between the upper die 40 and the top of the form members 19, this web will be substantially protected from contact with the quenching fluid so that this web will remain tough after the quenching operation.

For quenching drums which are not provided with the lower flange 36 I have provided the structure illustrated in Figure 4 of the drawing. In this view, it will be noted that there is provided the guard ring 45′ which is mounted in the die 12′ in a manner similar to the mounting of the bearing ring

45 in the die 12. In place, however, of the guard ring 49, there is provided a ring 53 which is mounted by means of a plurality of spaced bolts 54 in the recess 55 formed in the bearing ring 45′. The upper face of the guard ring 53 is plane so as to form an intimate contact with the lower edge 56 of the brake drum 57. It will thus be seen that a tight seal will be formed between the lower edge of the brake drum 57 and the lower die 12′ so that quenching fluid forced upwardly through the lower die 12′ will be prevented from passing outwardly between this lower die 12′ and the lower edge of the brake drum.

From the above, it will be apparent that I have provided a method and apparatus whereby brake drums may be quenched by first contacting a quenching fluid with the inner periphery of the brake drum, while maintaining the outer periphery of the brake drum free from contact with the quenching fluid and that subsequently the quenching fluid will be permitted to contact with the outer periphery of the brake drum to completely quench the brake drum. It will further be apparent that I have provided means which function not only to seal the lower edge of the brake drum, but also to permit the apparatus to be efficiently used on brake drums of varying heights, so that a single apparatus may be used for a number of different types of brake drums.

While I have disclosed my invention as adapted particularly for the quenching of brake drums, it is to be understood that the description is for the purposes of illustration only and that the inventive principles may be embodied in apparatuses for quenching articles of any size or shape, or for treating articles of any size or shape with any character of a fluid. The particular embodiment disclosed therefore is not to be construed as definitive of the limits of my inventive idea, and I reserve the right to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claims.

What I claim as my invention is:

1. The method of quenching a brake drum which consists in initially directing a quenching fluid into contact with one face of the heated drum while preventing contact of the quenching fluid with the other face of the drum, and in subsequently permitting contact of the quenching fluid with the second mentioned face of the drum.

2. Those steps in the method of hardening a brake drum which consists in initially directing a quenching fluid into contact with the inner periphery of the heated drum while preventing contact of the quenching fluid with the outer periphery of the drum and in subsequently flowing the quenching fluid into contact with the outer periphery of the drum.

3. The method of quenching a brake drum which consists in initially directing a quenching fluid into contact with the inner periphery of the heated drum, subsequently directing a quenching fluid into contact with the outer periphery of the drum, and in maintaining the web of the drum free from contact with the quenching fluid during the entire quenching operation.

In testimony whereof I affix my signature.

WALTER G. HILDORF.