

Jan. 2, 1940.

F. T. WARD

2,185,483

METHOD OF PREPARING HIGH MANGANESE STEEL MEMBERS AND THE PRODUCT THEREOF

Filed April 6, 1938

2 Sheets-Sheet 1

Fig. 1

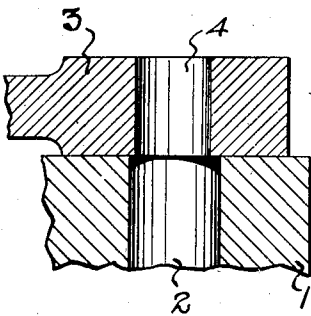


Fig. 2

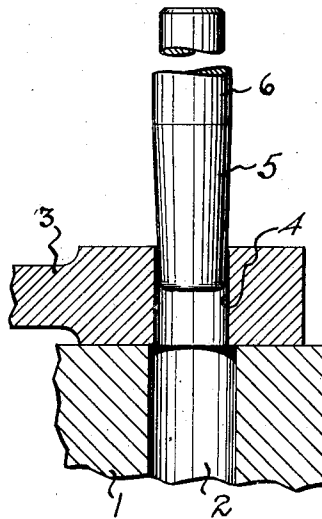


Fig. 3

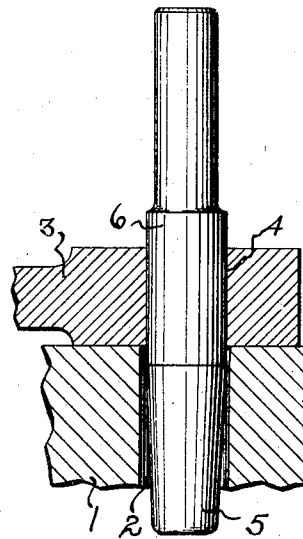


Fig. 5

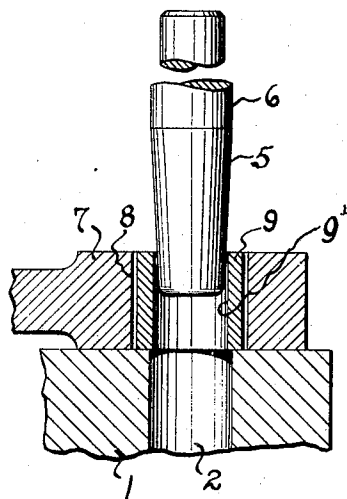


Fig. 6

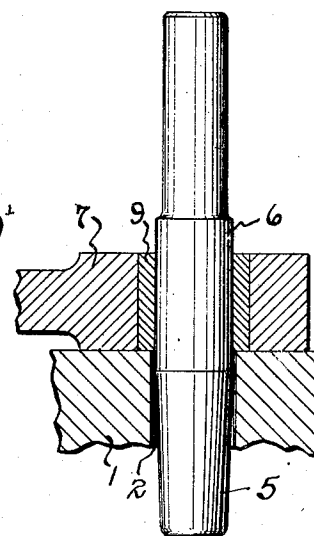
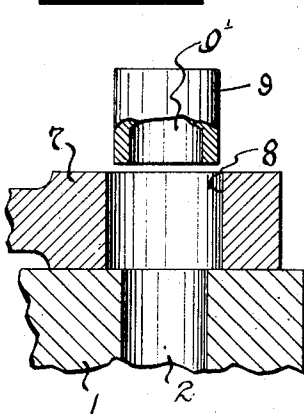


Fig. 4



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2 Sheets-Sheet 2

Fig. 7

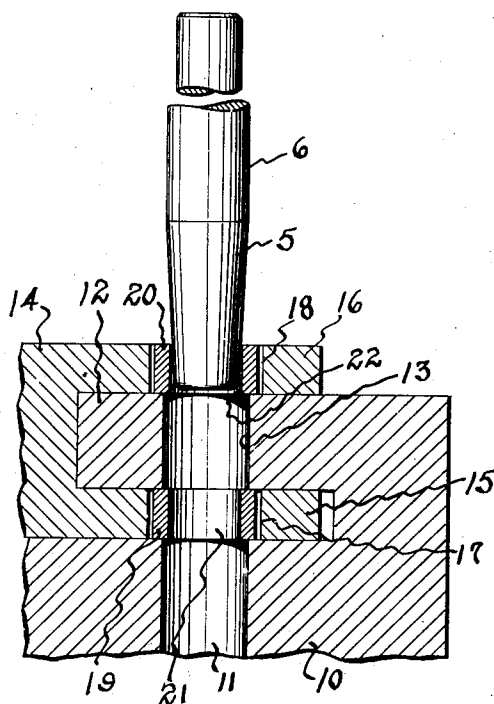


Fig. 8

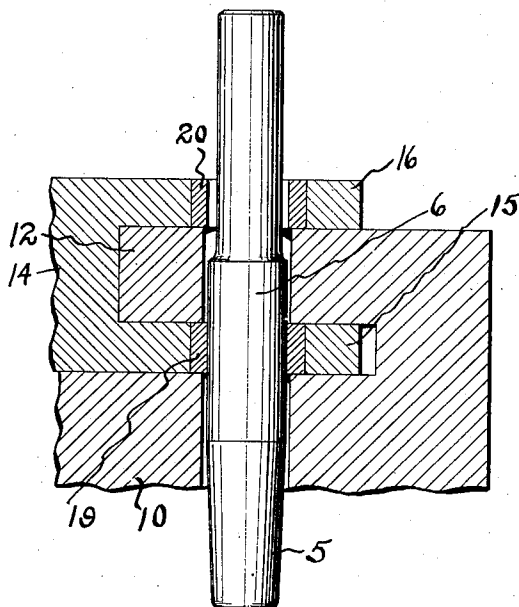
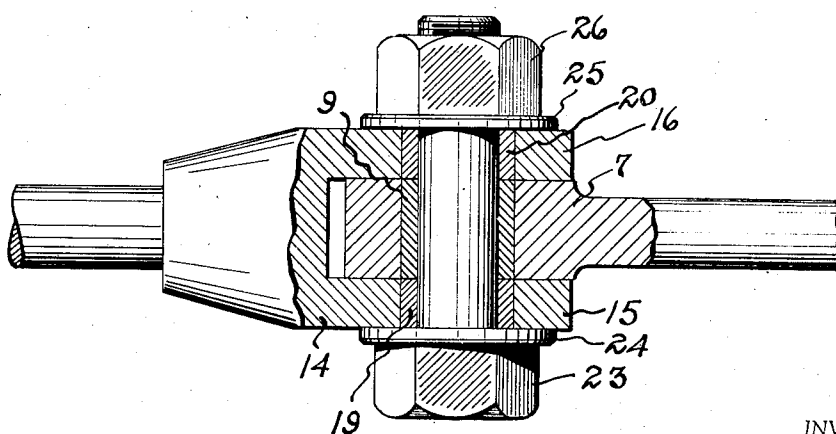


Fig. 9



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UNITED STATES PATENT OFFICE

2,185,483

METHOD OF PREPARING HIGH MANGANESE
STEEL MEMBERS AND THE PRODUCT
THEREOF

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Application April 6, 1938, Serial No. 200,553

12 Claims. (Cl. 29—148.2)

This invention relates to methods of preparing members such as levers, brake shoe heads, and other castings and forgings of high manganese steel to provide bearing surfaces therein and the product thereof.

The invention herein disclosed consists of methods and the products thereof by means of which castings and forgings of high manganese steel may be treated to provide bearing surfaces therein exactly sized, thereby increasing the range of usefulness of such articles.

The full and detailed objects of this invention will be more readily apparent after a description of the nature and subject matter of the invention itself.

This invention resides substantially in the combination, construction, arrangement, relative location of parts, steps and series of steps, all in accordance with this disclosure.

In the accompanying drawings:

Figure 1 shows a vertical, central, cross-sectional view through a casting or forging of high manganese steel mounted on an anvil in preparation for treatment in accordance with this invention;

Figure 2 shows the next step in the treatment of the casting or forging;

Figure 3 shows a later step;

Figure 4 is a view similar to Figure 1, showing a step in another method in accordance with this invention;

Figure 5 shows the next step of this method;

Figure 6 shows a later step;

Figure 7 is a view similar to that of Figure 1, showing a step in a method, in accordance with that illustrated in Figures 4, 5 and 6 as applied to another form of high manganese steel casting or forging;

Figure 8 shows a later step in the treatment of the article illustrated in Figure 7; and

Figure 9 is an elevational view, partly in cross-section, of an association of high manganese steel castings or forgings treated in accordance with the process of Figures 5 to 8, inclusive.

The nature and characteristics of high manganese steel have been known for some time. High manganese steel is one containing manganese in the proportion of 11 to 14% and from 1 to 1.5% carbon, according to Hadfield, the discoverer. Among the outstanding characteristics of high manganese steel may be noted the fact that upon heating it between 950° C. and 1100° C. and then quenching, it becomes tough, ductile, non-magnetic, and extraordinarily wear-resistant, as exemplified by the fact that it cannot be satisfactorily machined because no known cutting tool will stand up when machining it. Another characteristic of such steel is that if it is worked cold, its surface becomes tougher and harder the more it is worked, in other words, the

more wear it is subjected to the more wear-resistant it becomes. However, in consequence of this very nature it is customarily necessary to size and process it by grinding, which removes the material in relatively small particles without hardening it to the unmachineable condition as does occur if any attempt is made to process it by cutting it with a tool. A further characteristic is its very high tensile strength, 60 to 80 tons per square inch, and its extraordinary elongation, 50 or 70 percent in six inches exceeding pure iron.

Where parts made of high manganese steel are pierced by holes for pins, bolts and similar connecting means, in accordance with present practice, these parts have to be either cast or forged with the holes in them or punched after they are cast. As is well known, holes in such castings and forgings cannot be cast or punched with sufficient accuracy to hold the openings thus formed to very small tolerances. In some cases it is possible to cast or forge the parts with the holes therein or punch the castings or forgings for holes slightly undersize and then grind them to size. In such cases, however, the surfaces defining the holes or openings are not left in the hardened condition that results in the maximum wear resisting ability. Mild steel bushings can be cast in the metal and hardened steel bushings can be pressed into punched or cast holes, but all these methods have obvious objections.

In other cases, these holes or openings are so small as to make it difficult to accurately grind them or in any event to require specialized and expensive grinding equipment. For these reasons, the use of high manganese steel is considerably abridged and it is not commonly used, for example, in such fields as for brake levers, brake shoe heads, and the like, on vehicles such as street cars, subway cars, railway cars, and the like. In at least one instance, however, notwithstanding this difficulty, high manganese steel brake shoe heads are being made and sold. In that case the brake shoe heads are being cast with the openings in them. Since, however, these castings are not formed with holes having close tolerances, the pins or bolts by means of which they are pivotally mounted are relatively loose, causing rapid initial wear and, more importantly, causing an undue amount of noise. At the present time, when industry is noise conscious, much effort is being made to devise ways and means to eliminate the more common sources of such noise. In the case of vehicle operation of the type referred to above, one of the major sources of noise is that encountered by the looseness in the pivotal connections between the brake levers, brake shoe heads, brake beams, their supports, and the like.

Where these parts are made of ordinary steel, of course, the wear between them and the pivot

pins or bolts is quite rapid and noise quickly develops. In the one case where high manganese steel brake shoe heads are employed the full advantage thereof is not obtained because of the difficulty of forming the openings to close tolerances and because of the relatively rapid initial wear which occurs in those heads because the state of the art up to now has not provided means to fully harden them to correct size. As a result, the only way to minimize the noise generated by the looseness between these parts is to bush the holes in the manganese steel. However, this is not a satisfactory solution because the superior wear resistance of the manganese steel is entirely sacrificed and the wearing life of the pivot pin or bolt and the parts connected thereby is reduced because it largely depends on the amount of looseness that originally exists when all parts are new and the rate at which wear and increased looseness occur. Of course, larger pivot pins or bolts can be used as a replacement if the manganese steel is not bushed, but this involves stocking of a large variety of sizes of accurately finished pins or bolts which is highly uneconomical and impractical. Furthermore, it would not be a complete solution of the problem because the holes in the parts do not wear evenly, with the result that the openings become more or less elongated so that even a larger pin or bolt would not eliminate the noise.

The excellent wear resisting characteristics of high manganese steel castings or forgings have not heretofore been available for these and other purposes because of the lack of knowledge of how to take advantage of this characteristic of such steel. Broadly speaking, it is the object of this invention to teach of a method of preparing parts of such steel having openings therein to take full advantage of the wear resisting characteristics thereof. It will, of course, at once be apparent that this invention is not limited to any particular form of part made of high manganese steel, and for this reason the parts illustrated in the drawings for the purposes of description of this invention are illustrative only.

There is shown by way of examples in Figures 1 to 3, inclusive, the end 3 of a lever cast or forged from high manganese steel. It is shown thus formed with an opening or hole 4 there-through which is formed as a result of the casting or forging. This hole is undersized with respect to its final desired size and, for example, assuming that its final size is to be one inch in diameter this hole should be cast or forged to have a diameter of about $\frac{3}{4}$ ". The lever is placed on an anvil 1 which has a hole 2 there-through slightly larger than the finished size of the hole 4 and in the illustration picked it would be somewhat larger than an inch in diameter. The lever, without being heated, is placed on the anvil as shown in Figure 1 and a steel pin having an initial tapered end 5 contiguous to a true cylindrical portion 6 having a diameter equal to that of the diameter of the sized hole, in this case one inch, is inserted in the hole. This pin is driven into the hole until its cylindrical portion 6 takes a position somewhat like that shown in Figure 3. As a result of the forcing of the pin into the undersized cast hole it is brought to the exact desired finished size and the forcing of the pin thereinto mechanically works the metal at the surface of the hole 4, imparting thereto the extreme hardness and wear resistance which is a characteristic of high manganese steel. Due to its extraordinary ductility the high manga-

nese steel lever will withstand the stretching that results. The pin is then withdrawn or, as is apparent, may be driven on through. The result is that the high manganese steel lever 3 is provided with a bore which is exactly the size desired and the defining surface which is thereby put into its hardest and most wear resisting condition. When such a lever is used, for example as the brake lever in a vehicle, the pivot pin which connects it to another part may gradually wear but no wear under any normal circumstances, even over long periods of time, will be noticeable in the bore of the lever because of the extreme hardness thereof at the bore. Thus the pin may be replaced by a pin exactly the same size as that originally used whereupon the connection will again be as tight as it was when it was new.

In Figures 4, 5 and 6 is shown another method in accordance with this invention in which the procedure of the previous method is employed but in a somewhat different manner. In this case the lever is illustrated at 7 made of such steels as are commonly employed for the various uses to which the lever would be put, depending upon its intended use. Thus in the case of a brake lever on a vehicle the lever 7 would be made of the steels usually employed for this purpose and formed with a bore 8 therein sufficiently large to receive a bushing which in turn could be given an internal bore of the desired size. The bushing, which is illustrated at 9 in Figure 4 in this case, is of high manganese steel and is cast or forged or rolled to have an external diameter such that it would freely slip within the bore 8 of the lever 7. The diameter of the bore 9' in the bushing is slightly undersized. The lever is placed on an anvil as before and a high manganese steel bushing 9, without being heated, is dropped therein as shown in Figure 5. A steel drift pin like that previously described is then driven into the bushing which expands it, as illustrated in Figure 5, so tightly into the bore 8 as to firmly fix it therein. At the same time the bore 9' through the bushing will be exactly sized and hardened. The result is that a brake lever or other part of ordinary steels or iron may be provided with a bore bushed with a high manganese steel bushing. It is, of course, well known that mechanical parts of a soft material have been bushed with a hardened material to form a bearing surface, but in those cases the bushings have been made of materials which may be easily worked to exact size then hardened, and then forced into the bore of the part under high pressure. This method could not be used in introducing a high manganese steel bushing into the part because the bushing could not be made properly sized and hardened for the same reasons as explained in connection with the bore in the lever of the previous process.

Figures 7, 8 and 9 illustrate the application of the method of Figures 4, 5 and 6 to a lever or part having a clevis at the end and made of ordinary steel or iron. In this case the anvil is shown at 10 having an over-hanging portion 12. The anvil and over-hanging portion are provided with aligned bores, as shown at 11 and 13, corresponding to the bore 2 of the anvil 1. The clevis arms 15 and 16 are fitted onto the anvil as shown so that the over-hanging portion 12 lies between them. These clevis arms are, respectively, provided with the bores 17 and 18 which are to be bushed. The bushings 19 and 20 of high manganese steel are placed in the

openings 17 and 18. The drift pin, as before, is then forced through the bushings 19 and 20 to expand them into the openings 17 and 18 to lock them in place. At the same time these bushings are exactly sized and fully hardened on their inner bores, as explained before.

In Figure 9 is illustrated a joint made from the lever 7 and a lever having the clevis 14. These parts are shown bushed, as explained above, and a pivot pin or bolt 23 is shown connecting them together. The usual washers 24 and 25 are employed and the nut 26 holds the parts together. As explained above, when the pivot pin or bolt wears so that these levers become undesirably loose, it is only necessary to replace the bolt or pivot pin to return the parts to their original condition because of the fact that the bushings are substantially wear-resistant, which quality arose, as explained above, as a result of the mechanical working of the metal defining the bores therein by the forcing of the drift pin therethrough.

As was pointed out above, and as repeated here for emphasis, the levers shown in Figure 9 are by way of illustration only since it is apparent that any mechanical parts that can be made of high manganese steel may be treated in accordance with the methods of Figures 1 to 3, inclusive, and any mechanical parts of other steels and iron may be bushed with high manganese steel bushings in accordance with the method of Figures 4 to 8, inclusive. I do not, therefore, desire to be limited by this disclosure to the treatment of any specific form of mechanical elements by the method herein disclosed since it is apparent that the method may be applied to all forms of mechanical elements having holes or apertures therein intended to provide bearing surfaces. I prefer, therefore, to be limited by the scope of the claims granted me rather than by the disclosure herein employed to explain the invention.

What I claim is:

1. A method of processing a mechanical part composed of high manganese steel having a bore therein, which comprises forming the part of high manganese steel containing about 11 to 14% manganese with an undersized bore therein and subjecting the part at the surface of the bore to pressure to size and harden it.

2. A method of processing a mechanical part composed of high manganese steel having a bore therein, which comprises casting the part of high manganese steel containing about 11 to 14% manganese with an undersized bore therethrough and subjecting the surface of the bore to pressure to size it and harden it.

3. A method of processing a mechanical part composed of high manganese steel having a bore therein, which comprises forging the part of high manganese steel containing about 11 to 14% manganese with an undersized bore therethrough and subjecting the surface of the bore to pressure to size it and harden it.

4. A method of processing a mechanical part composed of high manganese steel having a bore therein, which comprises forming the part of high manganese steel containing about 11 to 14% manganese by rolling so as to have an undersized bore therethrough, and subjecting the surface of the bore to pressure to size it and harden it.

5. A method of processing a mechanical part composed of high manganese steel having a bore therein, which comprises forming the part of high manganese steel containing about 11 to 14% manganese with an undersized bore therein and then forcing a pin through said bore having a shape complementary to the bore, and an external diameter equal to the desired finished size of the bore whereby the bore is sized and hardened.

6. A method of processing a mechanical part composed of high manganese steel having a bore therein, which comprises casting the part of high manganese steel containing about 11 to 14% manganese with an undersized bore therethrough and then forcing a pin through said bore having a shape complementary to the bore and an external diameter equal to the desired finished size of the bore whereby the bore is sized and hardened.

7. A method of processing a mechanical part composed of high manganese steel having a bore therein, which comprises forging the part of high manganese steel containing about 11 to 14% manganese with an undersized bore therethrough and then forcing a pin through said bore having a shape complementary to the bore and an external diameter equal to the desired finished size of the bore whereby the bore is sized and hardened.

8. A method of processing a mechanical part composed of high manganese steel having a bore therein, which comprises forming the part of high manganese steel containing about 11 to 14% manganese with an undersized bore therethrough by rolling, and then forcing a pin through said bore having a shape complementary to the bore and an external diameter equal to the desired finished size of the bore whereby the bore is sized and hardened.

9. A mechanical element composed of high manganese steel containing about 11 to 14% manganese and having an aperture therein, the metal defining the aperture being exactly sized and hardened.

10. A method of treating a steel mechanical part having an opening therein, which comprises inserting a high manganese steel containing about 11 to 14% manganese bushing in said opening and expanding the bushing in the opening to lock it in place.

11. A method of treating a steel mechanical part having an opening therein, which comprises inserting a high manganese steel bushing containing about 11 to 14% manganese in said opening, the hole through the bushing being undersize, and forcing a member through the bushing having an external diameter equal to the desired finished diameter of the opening in the bushing to expand the bushing to lock it in the opening of the member and to size and harden the material defining the hole in the bushing.

12. A mechanical part of the type described, comprising a metal member having a bore therein and a high manganese steel bushing containing about 11 to 14% manganese frictionally locked in said bore, the wall forming a passage in the bushing being of a desired finish size and hardened.

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