

Jan. 8, 1935.

L. J. MacGREGOR

1,986,937

QUOIT

Filed Sept. 10, 1932

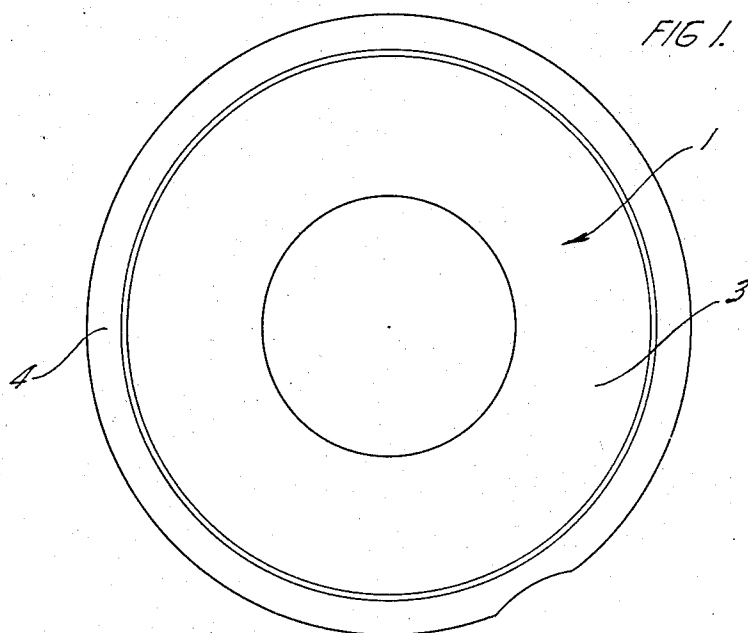


FIG. 4.

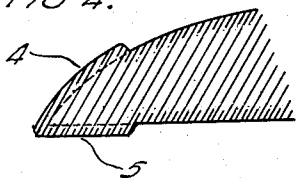


FIG. 2.

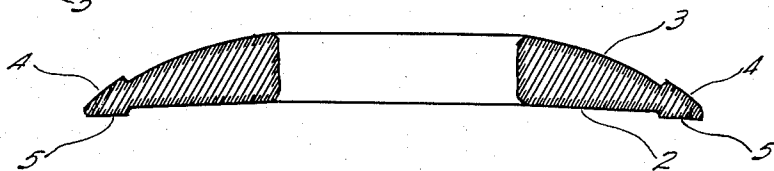
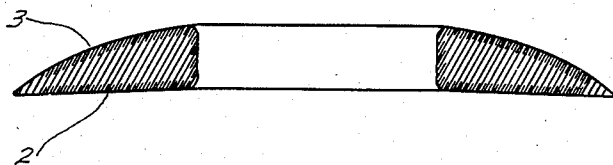


FIG. 3.



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Patented Jan. 8, 1935

780,988.7

1,986,937

UNITED STATES PATENT OFFICE

1,986,937

QUOIT

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Application September 10, 1932, Serial No. 632,472

5 Claims. (Cl. 273-106)

This invention relates to the production of metallic articles, the surfaces of which are designed to exhibit areas of contrasting degrees of hardness. In the preferred mode of carrying out my process to accomplish what I term "spot hardening", the metallic article during its manufacture is preliminarily formed with raised or protuberant portions of excess metal coinciding in location with the areas or spots where hard metal is to appear upon the finished surface of the article, which will usually be at those places where the article in use is most subject to wear or shock. After the article has been decarburized upon its surface, or case-hardened, to provide it with a thin crust of soft metal, the protuberant portions are cut away flush with the surface to expose the unaltered metal beneath this crust. Finally the article is subjected to suitable heat treatment to harden and temper it throughout at which time the spots of exposed inner metal will take on a hardness and temper with the core while the soft surface crust will remain relatively unaffected by this treatment. Alternatively, the protuberant portions may be allowed to remain upon the article until after it has been hardened and tempered, these portions being ground off in a finishing operation to expose the hard metal beneath the surface crust of softer metal.

While the process of the invention in its broader aspect is not limited to the making of any specific articles, nevertheless it finds especially useful application in the manufacture of quoits, used in playing the game of quoits, and results in the production of a quoit of improved construction. According to present practice, quoits commonly are made by either casting or forging. Quoits made by casting, however, are particularly susceptible to chipping and breakage because of their relatively brittle composition; and, because of the frequent occurrence of latent defects in quoits made by the ordinary methods of casting, they are liable to fail under shocks caused by the pounding of one quoit upon another in play.

Quoits made by forging, on the other hand, are according to present practice usually composed of relatively soft metal such as may be flowed between dies during manufacture so that their relatively thin circumferential edges soon grow jagged and burred in use and no longer present a convenient grip to the hand of the player. Except for this disadvantage, however, quoits of the latter type are to be preferred because of the tendency of the soft metal upon

their surfaces to retard skidding of one quoit upon another and, to a certain extent, to reduce shock caused by the clashing of the quoits against each other when in use.

By my process a stronger and more durable type of quoit can be cheaply and expeditiously produced, and one which is free of the objections inherent in those now known. In applying the process to the manufacture of quoits, the quoit forging is initially formed with an overlay of excess metal upon its circumference. Then the forging designedly is decarburized upon its surface, the overlay metal ground away to reveal the inner metal, and the forging finally heat treated to harden and temper it, or the forging may be hardened and tempered before removal of the excess metal. This produces a quoit having a circumferential rim of very hard metal which will not chip nor deform after prolonged use, while the remainder of the quoit is covered with a crust of soft material having the advantages before described.

The invention will be better understood from the following detailed description of one preferred mode of practicing the process of my invention and the novel type of quoit produced thereby, reference being had to the annexed drawing in which

Figure 1 is a plan view of a quoit forging as it appears at the stage after decarburization;

Figure 2 is a cross-section of the forging of Fig. 1 taken along its diameter;

Figure 3 is a cross-section of the same forging after removal of the excess metal upon its circumference and after hardening and tempering; and

Figure 4 is an enlarged cross-sectional detail showing of the forging of Fig. 2.

As shown in Figs. 1 and 2, the metal forging as it comes from the drop hammer comprises a ring-like metal disk 1 provided with a substantially flat but slightly concaved bottom side 2 and a convex top side 3. While this forging may be fashioned from other suitable materials, I have found that a silico-manganese steel corresponding to S. A. E. specification 9250 and containing approximately .50 per cent C, 2.00 per cent Si and .70 per cent Mn, lends itself very well to the process of the invention.

The forging as thus preliminarily formed will not differ materially from a quoit of conventional size and shape except that upon its circumference there is provided an overlay of excess metal which is designed to be removed in a subsequent stage of manufacture. This excess

metal completely surrounds the circumference of the forging and defines two protuberant rings 4 and 5 disposed respectively upon its top and bottom sides. These rings are about one-eighth of an inch in thickness, measured from the dotted line surface indicated in Fig. 4 which latter represents the normal finished surface of the quoit, and their width is such that they cover only a comparatively small area upon the top and bottom of the forging.

The forging after initially being subjected to an annealing or normalizing operation to render the metal homogeneous throughout, as is well known in the art, is heated for about four hours in an oxidizing atmosphere or flame at a temperature of about 1450 degrees F. so as to decarburize the outer surface of the forging and provide it with a skin or crust of soft metal. This crust need not penetrate beyond 1/32nd or 1/16th of an inch and in any event ought not to exceed the thickness of the rings of metal 4 and 5. This decarburization treatment robs the surface of the forging of a large part of its carbon—in the case of silico-manganese steel as specified the carbon content is reduced from approximately 50 per cent to approximately 20 per cent—but the interior metal of the forging is substantially unaffected by this treatment and retains its original relatively high carbon content.

Following decarburization, the forging is placed in a lathe and the protuberant rings of metal 4 and 5 are ground off by an abrasive wheel or other suitable means to a depth corresponding to the dotted line surface shown in Fig. 4 to expose upon the circumference of the forging the interior metal constituting its core or body and which was not influenced by the preceding decarburization treatment.

This circumferential rim of exposed metal while harder than the surface covering on the top and bottom of the forging, is nevertheless too soft to satisfactorily constitute the edge of the quoit, so that further treatment is necessary to impart to it the requisite degree of hardness. The forging is therefore again heated, this time at a temperature of about 1600 degrees F. for about three-quarters of an hour, and then quenched in oil. By this operation the annulus of core metal which was brought to light by the removal of the rings 4 and 5 and which contains its original high percentage of carbon will take on an intense hardness; while the surface of the forging which was softened in the preceding decarburizing treatment and which is of relatively low carbon content—only about 20 per cent in the case of the silico-manganese steel mentioned above—will be impervious to the treatment. Consequently the surface crust will remain substantially unchanged and will retain its former attributes.

As the concluding step of this heat treatment, the forging is heated at a temperature of about 700 degrees F. for about two hours to impart to it the proper temper, in a manner which is well understood in the art, resulting in a quoit as illustrated in Fig. 3, constituted of a core and circumferential edge of intense strength and hardness and a superficial crust of softer metal.

It is not necessary that the removal of the rings of excess metal precede the hardening and tempering step. For example, the method of the invention may be carried out by initially decarburizing the surface of the forging to impart to it a crust of soft metal, then hardening and tempering the body of the forging as before described. The rings 4 and 5 will then be removed to develop the circumferential rim of hard metal. In this event however, the excess metal will be very resistant because of prior hardening, but its removal may be accomplished by an abrasive wheel.

It is obvious that the crust or coating of soft metal may be applied to the forging in ways other than those which have been described. For example this may be accomplished by dipping, by sherardizing or by electro-deposition, the circumference of the forging being cleared of the coating material in a subsequent operation. Or a separate rim of hard metal may be shrunk onto the circumference of the forging. Such a novel form of quoit, irrespective of how produced, is deemed to fall within the purview of this invention.

I claim:

1. A quoit having a core of relatively hard metal and a superficial crust of soft metal covering substantially the entire surface of the core, except upon its circumference.

2. A quoit having a core of relatively hard metal and a superficial crust of soft metal located a spaced distance inwardly of the circumference of the quoit.

3. A quoit having a core of relatively hard metal and a superficial crust of soft metal covering the major portion of its surface, the said core and crust being of the same kind of metal but of different degrees of hardness.

4. A quoit of disk form having a core of relatively hard metal and a thin superficial crust of soft metal integrally united with the core, said crust covering the upper and lower surfaces of the quoit and terminating a spaced distance from its circumference.

5. A steel quoit having a core of relatively high carbon content and a crust of relatively low carbon content covering the major portion of its surface.

LOUIS J. MACGREGOR.