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APPARATUS FOR TREATING DRILL BITS

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Fig. 1.

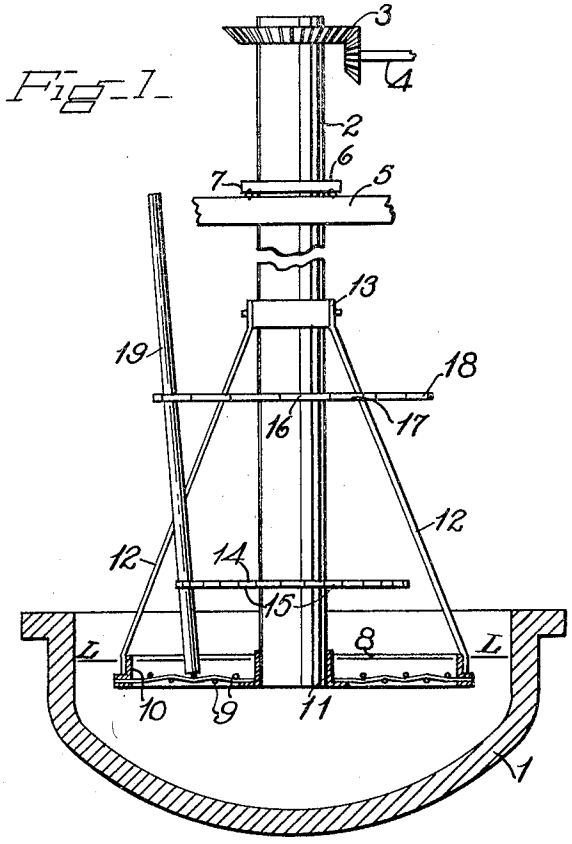
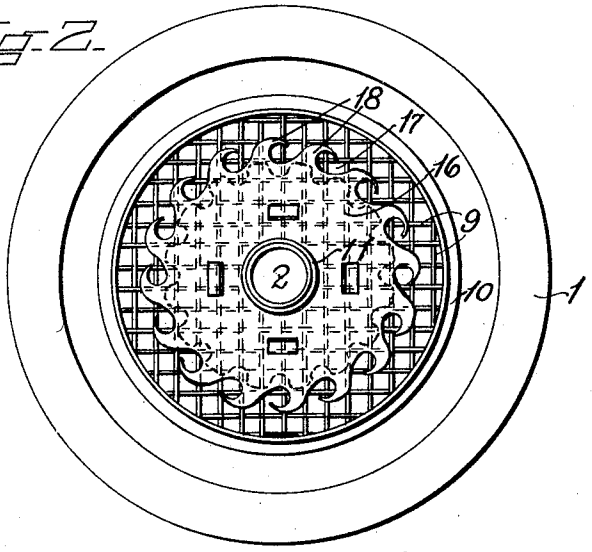


Fig. 2.



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APPARATUS FOR TREATING DRILL BITS

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7 Claims. (Cl. 266—6)

This invention relates to a device for treating drill bits that are made of steel in which their wearing and drilling qualities are more nearly uniformly increased than has heretofore been the practice and at the same time the drill bits are maintained in such condition that they will not become easily broken. The device is for treating drill bits after they have been sharpened by heating them up to a temperature within narrow limits by inserting the bits into a bath of hot material and maintaining them thereon for a predetermined length of time and then suddenly cooling the bits by plunging them into water that is maintained within certain temperature limits. In this way the cutting edges of the bits are made extraordinarily hard so as to resist abrasion and wear, the shanks or main portions of the steel drills are left unchanged, and the hardened edges are connected to the remainder by steel that has been altered so that it is very tough and will not be easily broken.

If steel, which contains the proper amount of carbon to make is suitable for use in making drills for rock and the like, has been forged correctly, it can be treated in this apparatus so that the steel bits are uniformly altered to improve the qualities.

An illustrative embodiment of the apparatus is shown in the accompanying drawing in which Fig. 1 is a side view partly in section and Fig. 2 is a plan view with parts omitted.

In the drawing reference character 1 indicates a vessel for containing molten lead or melted salt. This vessel may be heated in any convenient way to melt the contents or the contents can be kept in a molten state in any convenient manner. A pyrometer (not shown) is set in the hot liquid and utilized in controlling the temperature.

A vertically disposed shaft 2 is located above the vessel 1 with its lower end extending into the vessel. The shaft 2 may be revolved, preferably at a fixed unform rate, as for example by means of gears 3 driven by the shaft 4 from any convenient source of power. A support 5 is provided for the shaft 2 and a collar 6 may be provided on the shaft between which collar and the support 5 ball bearings 7 are indicated.

A reticulated support 8 is illustrated at the lower end of the shaft 2 in the vessel 1 upon which the drills rest. The support 8 is immersed in the molten liquid in the vessel 1 to a depth which will permit the drill bits which rest upon this support to extend into the molten material the desired extent. The extent to which the drills preferably extend into the molten liquid is indicated by the line L—L in Fig. 1. The reticulated support 8 is shown as comprising crossed wires 9, a ring 10 along the outer edge, and a flanged collar 11, although other supports may be used which would permit the liquid to reach the drill bits. The flanged collar 11 is attached to the lower end of the shaft and the ring 10 is connected to the shaft 2 by means of straps 12 which extend to a collar 13 that is attached to the shaft.

A disc 14 on the shaft 2 is spaced a short distance from the lower end thereof and is provided with spaced slots 15 around its periphery of sufficient size to receive the drills or drill rods.

A circular plate 16 is attached to the shaft 2 some distance above the disc 14. The plate 16 is provided along its periphery with a series of curved slots 17 of such a shape that hooks 18 are left at the edge of this plate. The number of hooks 18 corresponds to the number of slots 15 in the disc 14.

In operating the device the shaft 2 is slowly turned and the support 8 is kept immersed in the molten liquid in the vessel 1 a sufficient distance to cause the bits or lower ends of the drills to extend slightly below the surface of the molten material to a predetermined depth. Only one of the drills 19 is indicated in Fig. 1, to avoid confusing the drawing. When long drills are to be treated each drill is put in place by resting its bit upon the support 8 and causing the rod of the drill (or shaft of the drill) to enter one of the slots 17 in the plate 16 so that it leans outwardly, as indicated in Fig. 1, and is held in that position by means of the corresponding hook 18. When short drills are to be treated, each bit is put in place by resting it upon the support 8 and causing the drill rod to enter one of the slots 15 in the disc 14 so that it leans inwardly. The angle of lean in each instance is not so great as to cause an appreciable difference in depths of immersion of different sides of the bits. The amount of divergence of the upper end of the long drills from the shaft and the convergence of the short ones toward it will depend to some extent upon the positions and sizes of the disc 14 and plate 16. The drills are usually from 3 to 10 feet in length. The length of time the bit is kept in the heating fluid is easily regulated either by the speed at which the shaft 2 is turned or by the length of the arc through which the bit is permitted to pass before it is removed and plunged into water to cool it, or by a combination of the speed and length of arc. By inserting each drill at a fixed point with respect to the vessel 1 and removing it at another fixed point on the circumference of a

circle each bit is treated uniformly in the heating process without changing the speed of rotation. By changing the lengths of travel or speed of travel the time of heating can be varied for bits of different sizes, thus obtaining uniformity of results.

Steel that is suitable for making rock drills usually contains about 0.85 per cent of carbon. When steel is used for making drills it should not be overheated in forging and it should not be subjected to unnecessarily prolonged heating, because if the steel has been "burnt" or carbon removed from the surface thereof by oxidation at high temperatures, or the crystalline structure coarsened by prolonged heating during the forging operation, it is rendered unsuitable for hardening by any simple process when the best drill bits are desired. The forged drill rods before treatment may consist of a mixture of iron and iron carbide. When this sort of steel, or eutectoid steel having about 0.85 per cent of carbon therein is heated above the temperature of about 1370° F., certain internal changes take place. The iron carbide appears to become dissolved in the iron, the changes are accompanied by absorption of heat and the steel loses its magnetic properties at this temperature which is known as the upper critical temperature or decalescence point. If eutectoid steel is heated above the critical temperature and slowly cooled it assumes a form called "pearlite" in which the carbon that was dissolved is precipitated and the steel is relatively soft. If the steel is cooled more rapidly, certain mixtures or aggregates called "sorbite" and "troostite" are formed. If the steel is cooled very rapidly from above the critical temperature a very hard product called "martensite" is produced. It is comparatively brittle but strongly resists wear or abrasion. A less rapid rate of cooling the steel results in the production of what is known as "troostite" that is harder than sorbite and much softer, tougher and less brittle than martensite.

By this invention steel bits are produced of uniform excellence having an outer shell of martensite with the core of troostite connecting the martensite to the steel rod which is a mixture of sorbite and pearlite.

The invention will now be specifically described with a particular example, but it is to be understood that it is not restricted to this example. Eutectoid steel having about 0.85 per cent of carbon therein is forged into drill rods of, say, one inch gauge diameter and 3 to 10 feet long, and the ends of the rods are formed into the shape of drill bits without prolonged heating or overheating the steel. The rods are placed in the slots 17 of the device described above in such positions that the drill bits will be immersed to a depth of about 1 inch in the bath 2 which may be molten lead or a mixture of 78 per cent barium chloride and 22 per cent sodium chloride or other metal or salt compound having suitable qualities maintained at a temperature of about 1420° F. The bits are ordinarily kept in a lead bath about 2 minutes or in the salt compound bath about 6 minutes, and are then taken out and before having time to cool appreciably they are plunged to a depth of about 10 inches into water at a temperature between 65° F. and 95° F. that is kept circulating sufficiently to maintain uniform temperature.

As a result of this treatment, the bits have martensite along the cutting edges of the bit about $\frac{3}{16}$ to $\frac{3}{8}$ of an inch thick which extends back on the bit for about an inch. The hard shell of martensite is backed by a core of tough troostite and the portion of the rod of mixed pearlite and sorbite into which the troostite merges is substantially unchanged by the treatment.

The ends of the bits should be inserted into the heating liquid only to such a depth that the transformation line, that is, the limit of martensite at the surface, should fall inside the upset portion of the bits where there is a greater cross sectional area of steel, and the drills have greater strength. The heating liquid, whether lead or a salt, should not rise so far in the central bore holes of the bits that it would stick and freeze in them, thus partially or completely stopping the holes. By removing the heated drills and quenching them by hand, the operator can jar the bits and thus shake the liquid out before quenching. This may be done, for example, by striking the bits against a wooden block in transit.

By this invention a greater excellence and uniformity of product is obtained. The invention is applicable to steel having other percentages of carbon than mentioned above and to alloy steels, each having its own temperature limits and appropriate time for heating.

Among the advantages of this invention may be mentioned:

The heating of the drill bits is accomplished in such a way that the temperature to which the bits are heated is accurately controlled; the bits can be removed as soon as they have reached the correct temperature; the apparatus used is simple and cheap and can be operated satisfactorily without requiring highly skilled operators or long course of training for them; the heating operation is performed very rapidly and evenly in a bath of molten liquid; the cost of heating the bits is greatly lowered compared to prior practice; the depth of immersion of the bits is easily regulated so that the martensite structure is kept within the expanded section of the bit; substantially perfect conditions of heating as to temperature, time and extent is secured; the quenching can be performed by hand at the exact desired moment of time, and any molten liquid can be jarred out of the bit before it is quenched.

I claim:

1. In a device for treating steel bits, a vessel for melted heating material, a vertically extending revoluble shaft above said vessel, a reticulated support carried by the lower end of said shaft in said vessel, and means connected to said support for maintaining drill bits in an upright position upon said support.

2. In a device for treating steel bits, a vessel for melted heating material, a vertically extending revoluble shaft above said vessel, a reticulated support carried by the lower end of said shaft in said vessel, and spacers on said shaft for said bits.

3. In a device for treating steel bits, a vessel for melted heating material, a vertically extending revoluble shaft above said vessel, a reticulated support carried by the lower end of said shaft in said vessel, and means on said shaft to space bits circumferentially around it.

4. In a device for treating steel bits, a vessel for melted heating material, a vertically extending revoluble shaft above said vessel, a reticulated support carried by the lower end of said

shaft in said vessel, and means on said shaft to hold said bits around it diverging in an upward direction.

5. In a device for treating steel bits, a vessel for melted heating material, a vertically extending revoluble shaft above said vessel, a reticulated support carried by the lower end of said shaft in said vessel, and means on said shaft to hold said bits around it diverging in an upward direction, said means comprising disc-shaped members.

6. In a device for treating steel bits, a vessel for melted heating material, a vertically extending revoluble shaft above said vessel, a reticulated support carried by the lower end of said shaft in said vessel, and means on said shaft to hold said bits around it diverging in an upward direction, said means comprising disc-shaped members, one of which is provided with hooks along its edge.

7. In a device for treating steel bits, a vessel for melted heating material, a vertically extending revoluble shaft above said vessel, and a circularly shaped support carried by the lower end of said shaft upon which the lower ends of said bits rest, said support being connected to said shaft at its central and edge portions.

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