1996127

(19) **PATENT BUREAU OF JAPAN (JP)**

(12) OFFICIAL PATENT REPORT (A)

6,099,391

(11) Patent Application Publication Number:	Hei 8-73930
(43) Publication Date:	March 19, 1996
Number of Inventions:	3
Total Number of Pages:	5
Request for Examination:	None

(51) Int. Cl.[6]	I.D.	Inter-Office Number	FI	Technology Display Area
C21D 7/06	Z	8821-4K		
B23P 15/14				
B24C 1/10	Z			
C21D 1/06	Z			

(54) Title of Invention: A Strengthening Method for Metal Parts

(21) Patent Application Number: H6-217214

(22) Patent Application Date: September 12, 1994

(72) Inventor: Teiji Suzuki
c/o Honda Engineering, Co., Ltd.
1-10-1 Shinsayama, Sayama City, Saitama Pref.

Inventor: Tadao Sugano
c/o Honda Engineering, Co., Ltd.
1-10-1 Shinsayama, Sayama City, Saitama Pref.

(71) Applicant: 000005326
Honda Motor Company Ltd.
1-1 Aoyama 2-chome, Minato-ku, Tokyo

(74) Agent: Patent Attorney, Takehiro Chiba (and one other)

Description

(54) **[Title]** A Strengthening Method for Metal Parts

(57) **[Abstract]**

[Purpose] To improve surface smoothness and fatigue strength and to easily increase working efficiency.

[Structure] A mixture of water 16 and glass beads 20 is injected toward the bottom, 30, of a gear 24 that has been machined by gear cutting. Therefore, glass beads 20 are injected toward gear tooth bottom (land) 30 with directivity. Compression stress is thus provided to the surface of gear tooth bottom (land) 30 and the surface is polished by these glass beads 20 and water 16.

[Scope of Patent Claims]

[Claim 1] In regard to a method for strengthening metal parts, a method for strengthening metal parts characterized by injecting water mixed with glass beads toward the metal parts after machining.

[Claim 2] In regard to the strengthening method described in Claim 1, a method for strengthening metal parts characterized by the fact that the diameters of the glass beads fall within the range of 0.05 mm to 0.3 mm and the injection pressure of the liquid described above is 98 Mpa or higher.

[Claim 3] In regard to the strengthening method described in Claim 1, a method for strengthening metal parts characterized by the fact that the metal parts are gears.

[Detailed Explanation of Invention]

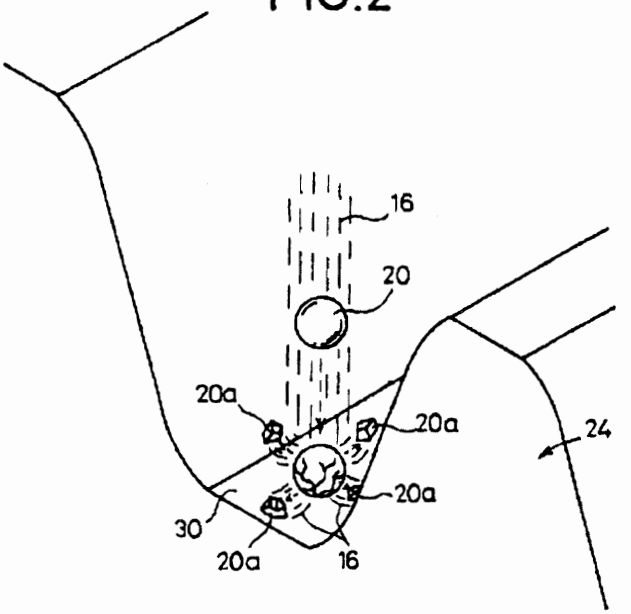
[0001]

[Industrial Application Field] This invention relates to a strengthening method for metal parts after machining.

[0002]

[Conventional Technology] In metal parts such as gears that are subject to repeated load while in use, fatigue strength must be increased. A method called shot peening is applied to provide compression stress to part surfaces via colliding steel balls, etc.

FIG.2



[0003] However, a problem occurs in that the part surface becomes rough and the surface roughness worsens because of the steel balls used in shot peening. Therefore, the following strengthening method of the metal surface has come to be known, as shown in Patent H5-21711. The surface of a metal form is quench-hardened and machined, then glass beads 0.2 to 0.6 mm in diameter are injected toward it. The fatigue strength of the metal surface is increased without roughening.

[0004]

[Problems to Be Solved by Invention] However, the problem of the conventional method described above is that the fatigue strength does not improve to the desired level because the compression strength decreases while the metal surface roughness is alleviated. In addition, because the directivity of the injected glass beads is not high, the glass beads spread in various directions, so the efficiency is extremely low, particularly when the glass beads are injected toward the gear tooth bottom (land).

[0005] This invention solves that problem. The objective is to provide a method for strengthening metal parts by alleviating the surface roughness and fatigue strength and easily increasing the working efficiency.

tooth bottom (land) 30, as do the glass beads, 20. Therefore, compression stress is provided to the surface of gear tooth bottom (land) 30 by water 16, and the surface is polished.

[0018] Therefore, compression stress is effectively provided to gear tooth bottom (land) 30 by water 16 and glass beads 20 in this application example. The fatigue strength of gear 24 increases, and strengthening of gear 24 can be achieved easily and effectively. In addition, the advantage of this application example is that the surface roughness of gear tooth bottom (land) 30 is alleviated and the precision of gear 24 becomes higher.

[0019] In this application example, gear tooth bottom (land) 30 of gear 24 made by machining is hardened and the surface of gear tooth bottom (land) 30 is polished. Accordingly, in comparison with the conventional method of injecting glass beads toward machined metal parts, the work on gear 24 is carried out more simply and quickly.

[0020] Next, the deddendum bending fatigue strength of gear 24 was measured after a strengthening process using water 16 and glass beads 20 with 0.1 mm diameters (Experimental Example 1), after a strengthening process using water 16 and glass beads 20 with 0.2 mm diameters (Experimental Example 2), without a strengthening process (Comparison Example 1), after a strengthening process using water 16 only (Comparison Example 2), and after a strengthening process using glass beads 20 with 0.6 mm diameters only (Comparison Example 3).

[0021] The strengthening conditions are shown in Fig. 4. The diameter of nozzle 14 of unit 10 is 0.2 mm. The diameter of focusing tube 26 is 1 mm. The distance between the tip of focusing tube 26 and the addendum of gear 24 is 50 mm. The injection pressure of water 16 is 2,000 kg/cm^2. The flow of glass beads 20 is 50 g/min. Unit 10 was swung to the left and right at a speed of 2 m/min and moved in the direction of the teeth width 1 mm per swing.

[0022] Samples of the Experimental Example 1, Experimental Example 2, and Comparison Examples 1 through 3 were set in a hydraulic fatigue tester (not shown) and stress was applied to the deddendum of each gear 24 by oscillating at 30 Hz. The results are shown in Fig. 5.

[0023] When only water 16 is used for strengthening (Comparison Example 2), the strength does not improve in comparison with Comparison Example 1. The increase in strength is small when only glass beads 20 are used for strengthening (Comparison Example 3). In contrast, the strength increases by approximately 37% at low cycles and over 50% at high cycles for both Experimental Example 1 and Experimental Example 2 in comparison with the unprocessed case (Comparison Example 1).

[0024] Next, an experiment was carried out to examine the relationship between the diameters of glass beads 20 and the fatigue strength or surface roughness. The relationship between the diameters of glass beads 20 and the fatigue strength is shown in Fig. 6. The relationship between the diameters of glass beads 20 and the surface roughness is shown in Fig. 7.

[0025] In this case, as shown in Fig. 6, glass beads 20 clog unit 10 by absorbing moisture when the diameters are 0.05 mm or less, so the strengthening process cannot be performed. When the diameters of glass beads 20 are 0.3 mm or greater, the surface exceeds the standard limit for roughness (3 μm).

[0026] Also, another experiment was carried out to examine the relationship between the injection pressure of water 16 and the fatigue strength. The results are shown in Fig. 8. When the injection pressure of water 16 is 98 Mpa or less, no noticeable effect on the material strength is observed. When the injection pressure is 238 Mpa or higher, glass beads 20 are broken and a problem might occur in post-processing.

[0027]

[Effects of Invention] As described above, the following effects are achieved by the strengthening method for metal parts of this invention.

FIG.1

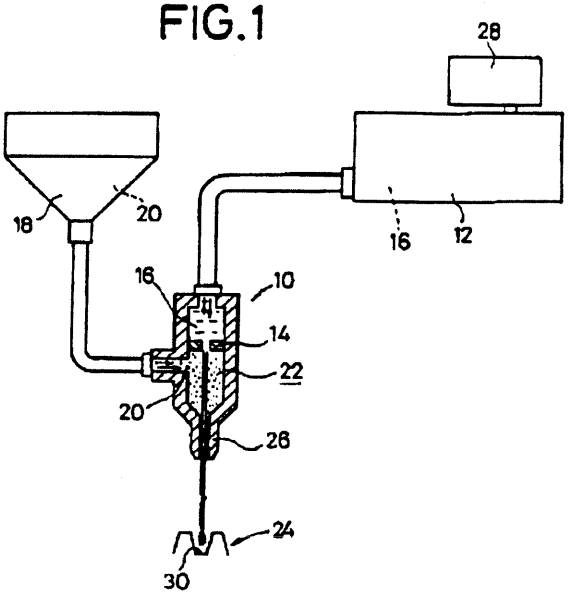


FIG.2

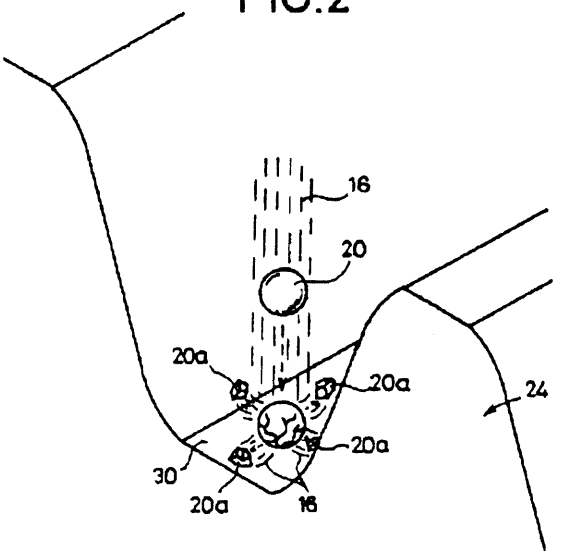


FIG.3

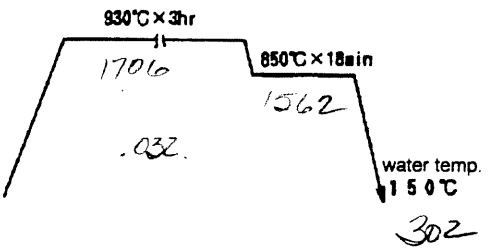


FIG.4