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Vickers

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[54] **METHOD AND APPARATUS FOR QUENCH HARDENING VALVE SEATS**

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[52] **U.S. Cl.** .... **266/4 E,** 148/141, 148/143, 148/144, 219/10.57, 219/50, 266/4 S, 266/5 E

[51] **Int. Cl.** **C21d 1/62**

[58] **Field of Search** .... 266/4 R, 4 E, 4 S, 6 PC, 266/6 S, 8, 5 R, 5 E, 5 EI, 4 EI; 219/10.57, 8.5, 59, 67; 148/131, 141, 143, 144, 146, 148, 149, 150, 152

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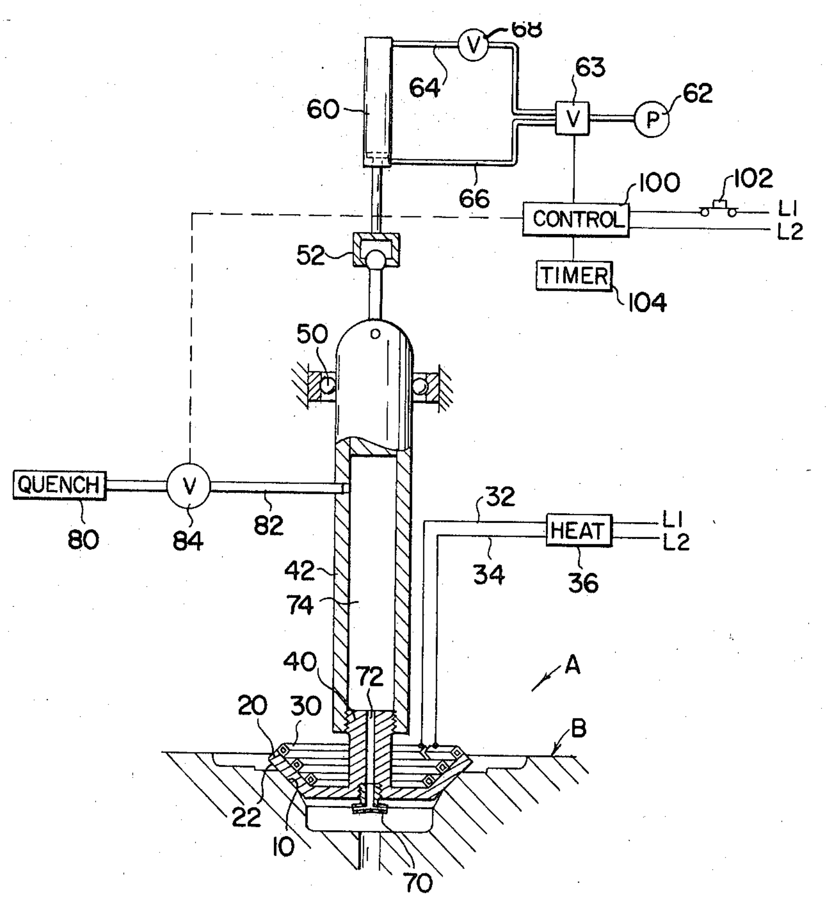
[57] **ABSTRACT**

An apparatus for hardening the conical surface of a valve seat of an internal combustion engine, which device comprises an iron having an outer conical surface matching the conical surface of the valve seat, means for heating the iron to a temperature at least as high as the quench hardening temperature of the valve seat surface, means for moving the iron into a position with the conical surface of the iron against the conical surface of the valve seat, timer means for maintaining the conical surfaces together for a preselected time, means for moving the iron away from the valve seat surface, and means for quenching the valve seat surface to provide a hardened wear surface.

9 Claims, 3 Drawing Figures



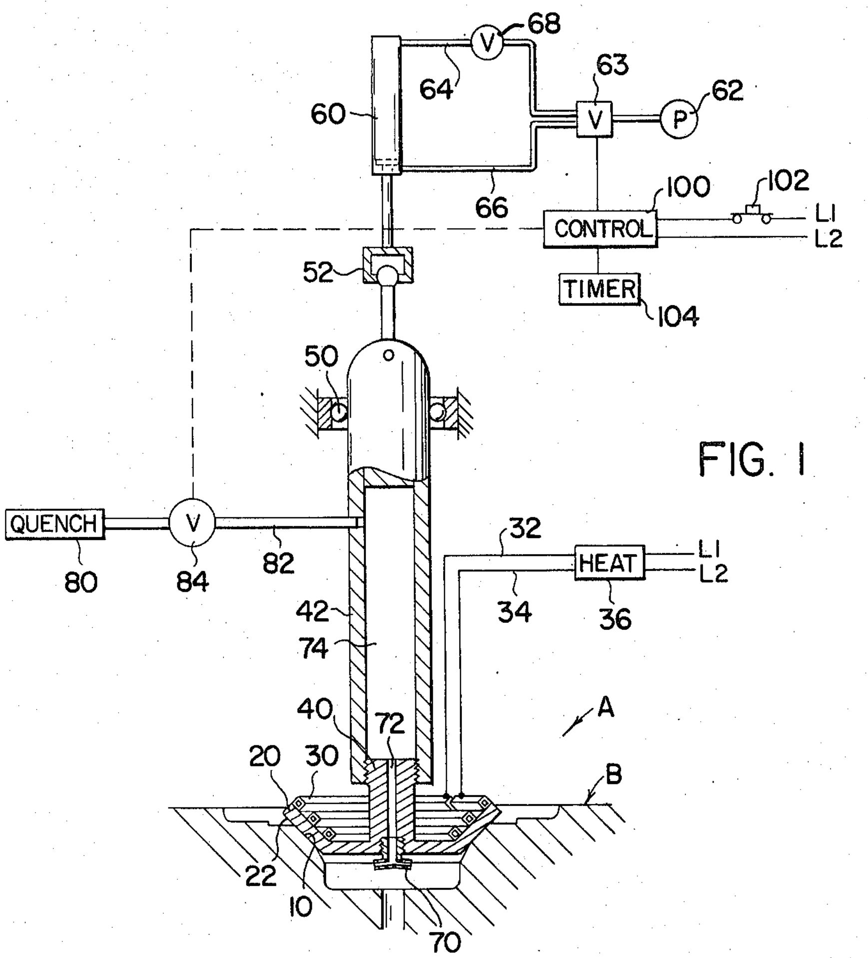


FIG. 1

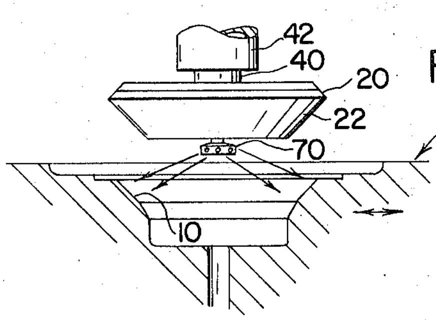


FIG. 2

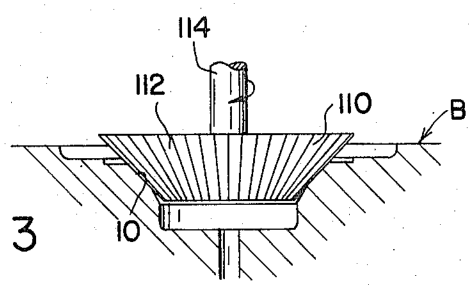


FIG. 3

METHOD AND APPARATUS FOR QUENCH HARDENING VALVE SEATS

This invention relates to the art of quench hardening valve seats of the type used in internal combustion engines and particularly to a method and apparatus for quench hardening the conical surface of valve seats of an internal combustion engine.

The invention is particularly applicable for quench hardening the valve seats of an internal combustion engine, and it will be described with particular reference thereto; however, it should be appreciated that the invention has broader applications and may be used for quench hardening various conical surfaces.

With the advent of low lead gasolines, it is now necessary to provide hardened valve seats in an internal combustion engine, particularly at the exhaust valve of the engine, to produce acceptable wear characteristics. Various devices have been employed for providing these hardened surfaces. In accordance with common practice, an inductor inductively heated the valve seat before quenching thereof. These devices have been quite successful; however, they are expensive and require complicated control arrangements. For instance, it is necessary in inductively heating the valve seats, to provide a very close spacing between an inductor and the valve seat preparatory to induction heating. This spacing is somewhat critical and requires a variety of devices to assure establishment of the air gap prior to heating. Such an arrangement is shown in prior patent application Ser. No. 151,498 filed June 9, 1971, and now abandoned.

The present invention relates to a completely different arrangement for heating valve seats preparatory to quench hardening, which apparatus does not require the complicated control for establishing an air gap between an inductor and the valve seat preparatory to heating.

In accordance with the present invention, the valve seat is heated by placing the conical surface of a heated iron against the conical surface of the valve seat. The iron is then removed from the valve seat, and the seat is quench hardened to produce the necessary wear resistance characteristics.

The primary object of the present invention is the provision of a method and apparatus for hardening a conical valve seat, which method and apparatus employs conduction heating of the valve seat preparatory to quench hardening thereof.

Another object of the present invention is the provision of a method and apparatus for hardening a conical valve seat, which method and apparatus does not require the step of establishing an air gap between the heating element and the valve seat preparatory to heating thereof.

These and other objects and advantages will become apparent from the following description taken together with the accompanying drawing in which:

FIG. 1 is a schematic, partially cross sectioned, side elevational view showing the preferred embodiment of the present invention;

FIG. 2 is a partial view similar to FIG. 1 showing a second operating position of the apparatus shown in FIG. 1; and,

FIG. 3 is a schematic view illustrating the optional preparatory processing step in the method of the present invention.

Referring now to the drawings wherein the showings are for the purpose of illustrating a preferred embodiment of the invention only, and not for the purpose of limiting same, FIG. 1 shows an apparatus A for quench hardening the conical surface **10** of an exhaust valve seat in engine head B. In accordance with the illustrated embodiment of the invention, an iron **20** includes an outer conical surface **22** conforming to the conical surface **10** of the valve seat. Heating coil **30** formed of molybdenum or other high melting material and appropriately coated to prevent oxidation is provided on the inner surface of the iron **20**. Leads **32, 34** connect the coil **30** with a heating control **36** powered by input lines **L1, L2**. Since the quench hardening temperature of the surface **10** is generally in the range of 1,700°F, iron **20** is heated to a temperature at least as high as the necessary temperature for hardening surface **10**. In practice, the temperature exceeds the hardening temperature by at least approximately 200°F. For instance, the iron **20** may be heated to approximately 2,000°F by the coil **30** connected to the heating control **36**. To decrease the time of the heating operation, it is possible to raise the temperature of the iron to 2,200°F or above. No matter which temperature range is selected, the metal forming the iron **20** must be such that it will not melt or rapidly oxidize. At lower temperatures, it is possible to employ certain tool steel; however, at higher temperatures other metals may be required. The selection of the metal for the iron and the material of the heating coil is within the knowledge of a person skilled in the resistance heating art.

Iron **20** includes an upwardly extending mounting boss **40** threadably received upon the lower end of a support rod **42**. Rod **42** is reciprocably mounted within bearings **50** so that the rod may reciprocate and also may have a certain transverse swinging movement to allow perfect seating of the surfaces **10, 22**. To allow for this movement, the upper end of rod **42** includes a swivel joint **52** for connecting the rod **42** onto a reciprocal drive means **60** in the form of a pneumatic cylinder controlled by an air supply **62** and a valve **63**. Extending from the valve **63** is a protracting line **64** and a retracting line **66**. The air within the first of these lines forces the rod **42** downwardly allowing surface **20** to engage surface **10**. Air in the second line **66** retracts the iron **20** into the position shown in FIG. **2**. When moving downwardly, it is desirable to control the pressure supplied by the iron **20** against the surface **10**. This can be accomplished, as illustrated, by a pressure control valve **68** within the protract line **64** extending from valve **63**. Of course, the pressure from supply **62** may be of the desired magnitude for use without a pressure control valve.

To provide the quenching function, various arrangements could be employed; however, in accordance with the illustrated embodiment of the invention, a quench nozzle **70** is secured to the lower end of heating iron **20** and is provided with a plurality of outwardly diverging fluid apertures. Bores **72, 74** within boss **40** and rod **42**, respectively, are used to supply quenching fluid to the apertures within the lower quench nozzle **70**. This quench fluid comes from a supply **80** through a conduit **82** controlled by a valve **84**.

The apparatus as so far described is utilized for moving the heated surface **22** into engagement with the seat surface **10**. After the desired time necessary to raise the temperature of the seat to the quench hardening temperature, cylinder **60** retracts rod **42** into the position shown in FIG. **2.** The heating time is determined by various factors such as the desired temperature of the surface **10** and the temperature of the surface **22.** After the iron is raised, valve **84** is opened to spray quenching fluid outwardly through nozzle **70** and thus quench harden the surface **10.** Any appropriate controls can be employed for causing the actions of the various elements. In accordance with the illustrated embodiment shown in FIG. **1** a schematically represented control device **100** powered by lines L1, L2 is used. A start switch **102** in line L1 initiates the heating cycle by actuating control device **100.** Timer **104** measures the time of contact between the surfaces **10, 22.** After a preselected time, timer **102** indicates to control **100** that valve **63** should be shifted. When this happens, rod **42** is moved upwardly into the position shown in FIG. **2.** A quench control line **106** then energizes the valve **84** to cause quenching of the previously heated surface **10.**

Referring now to FIG. **3,** in some instances, it is found that the surface **10** has certain irregularities from previous machining operations. Consequently, the fine machining reamer **110,** having an abrasive outer surface **112,** is brought into engagement with the surface **10** and is rotated by a drive shaft **114.** This assures matching of surface **110** with the surface **22** of iron **20.** In some instances the surface **10** is properly machined and this remaining operation is not required. However, it is desirable to perform this operation to assure proper fitting of the surfaces **10, 22.**

Having thus defined my invention, I claim:

1. An apparatus for hardening the conical surface of a valve seat of on internal combustion engine, said device comprising an iron having an outer conical surface matching said conical surface of said seat; means for heating said iron to a temperature at least as high as the quench hardening temperature of said valve seat surface; means for moving said iron into a position with said conical surface of said iron against said conical surface of said valve seat; timer means for maintaining said conical surfaces together for a preselected time, means for moving said iron away from said valve seat surface and means for quenching said valve seat surface.

2. An apparatus as defined in claim **1** wherein said heating means includes a resistance heating coil secured onto said iron.

3. An apparatus as defined in claim **1** wherein said quenching means includes a nozzle secured onto said iron and means for directing a quenching liquid through said nozzle.

4. An apparatus as defined in claim **1** including means for allowing said iron to move in a transverse direction whereby the surface of said iron nests in the surface of said valve seat.

5. An apparatus as defined in claim **1** including means for controlling the pressure between said surfaces when they are engaged.

6. An apparatus for hardening the conical surface of a valve seat of an internal combustion engine, said device comprising an iron having an outer conical surface matching said conical surface of said seat; means for heating said iron to a temperature at least as high as the quench hardening temperature of said valve seat surface; means for selectively moving said iron between a first position with said surface of said iron engaging said surface of said valve seat and a second position with said surfaces spaced appart; said moving means comprising a support rod secured at one end to said iron and secured at the second end to a drive means; means for holding said surfaces in engagement for a preselected time after said moving means shifts said iron into said first position; and, means for quenching said valve seat after said moving means shifts said iron into said second position.

7. An apparatus as defined in claim **6** including means for allowing said iron to move in a transverse direction when said moving means shifts said iron into said first position.

8. An apparatus as defined in claim **7** wherein said movement allowing means is a swivel joint between said second end of said rod and said drive means.

9. An apparatus as defined in claim **6** including means for controlling the pressure between said surface when said moving means shifts said iron into said first position.

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