United States Patent [19]

Ernst

[11] **3,760,635**

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[54] **DUROMETER**

[76] Inventor: **Alfred Ernst,** Via del Cairo 37, Varese, Italy

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[52] **U.S. Cl.** **73/82,** 73/85

[51] **Int. Cl.** **G01n 3/48**

[58] **Field of Search** .... 73/12, 141 R, 81, 73/82, 78, 139

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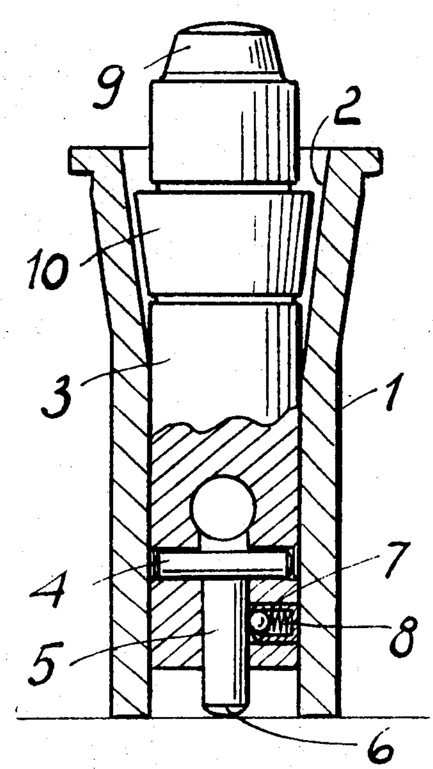
Primary Examiner—James J. Gill
Attorney—Michael S. Striker

[57] **ABSTRACT**

A durometer for measuring the hardness of materials, and a method of using such a durometer. An uncontrolled impact force applied to a shearing member causes an accurately dimensioned control bar to shear and thus applies a controlled force to a pin of low mass. The pin has a penetrating tip which makes an impression in the material, the size of the impression being dependant upon the material hardness. After shearing of the control bar, movement of the shearing member is damped to avoid rebound and subsequent deformation of the impression.

8 Claims, 4 Drawing Figures



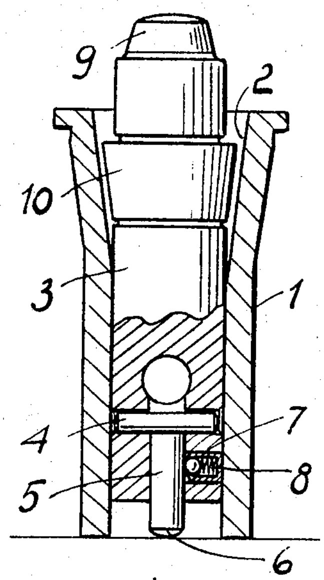


Fig. 1

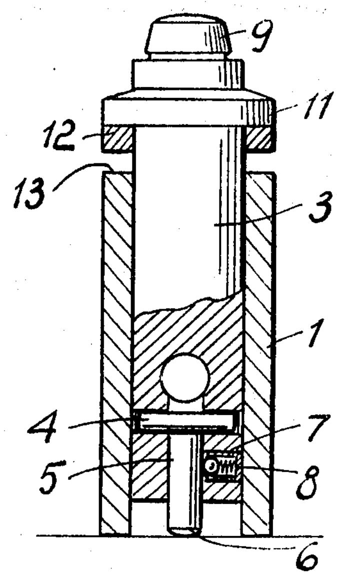


Fig. 2

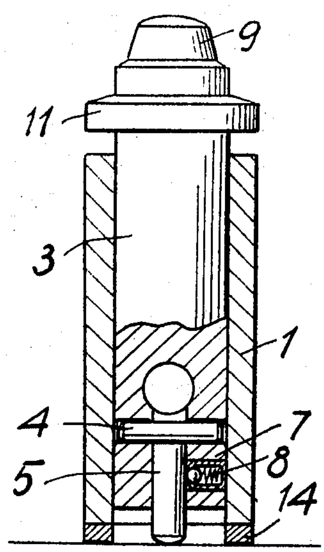


Fig. 3

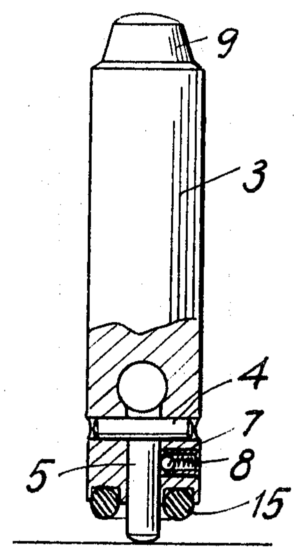


Fig. 4

DUROMETER

BACKGROUND OF THE INVENTION

This invention relates to durometers for measuring the hardness of materials and a method for using such durometers.

It is customary for the hardness of a material to be found by impression tests. In these tests a hardened steel ball (Brinell test) or a diamond point (Vickers test); for example, are pressed into the material to be tested under a measured force. The width, and thus depth of the impression formed and the hardness is expressed in terms of a hardness number which depends on the depth of the impression.

It has been proposed to provide durometers in which an external member, to which an uncontrolled external force is applied, is connected to a stem supporting a penetrating tip by an element which breaks when a predetermined force is applied. Thus, a controlled force can be applied to the tip. In one form of proposed durometer, the breaking element was a wire. This durometer, however, has disadvantages preventing accurate measurements of the hardness. One disadvantage is that the wires, intended to break during the operation of the durometer, are usually cut from a continuously formed wire and their shear properties are seldom constant and are often found to be well outside required tolerance limits at various locations along the wire length.

It has been further proposed to replace the wire by a control bar whose dimensions have been accurately adjusted so that the bar shears when a predetermined force is applied to it, the shearing force being within required tolerance limits. This improvement still suffered from drawbacks, however. One drawback was that the impression, made in the material whose hardness was to be measured, was often deformed due to rebound of the external member receiving the uncontrollable external force when this external member struck a shoulder after shearing of the control bar. The shoulder was provided to limit the stroke of the external member. A further drawback was that the use of such durometers often produced an impression which was not truly independent of the uncontrolled external force. When the control bar in such a durometer is broken, the penetrating tip initially moves with a speed which is dependent upon the speed with which the external member moves immediately after shearing. The depth of the impression made in the material whose hardness is to be measured therefore varies significantly if the penetrating tip, and any support member in which the penetrating tip is mounted, has a relatively large mass. It has been customary in prior durometers for the penetrating tip to comprise a hardened steel ball or a diamond point mounted in a solid support member.

It is therefore desirable to damp the movement of the external member to reduce rebound after shearing of the control bar. It is also desirable for the penetrating tip and any members which move with it to be of low mass.

SUMMARY OF THE INVENTION

The present invention provides a durometer comprising a penetrating tip, and a shearing member intended in operation to apply a force to the penetrating tip via a control bar which is dimensioned to shear when a predetermined force is applied to it by the shearing member, in which the penetrating tip is one end of a pin whose other end abuts the control bar, and in which the durometer is provided with damping means serving in operation to absorb kinetic energy of the shearing member after shearing of the control bar.

The invention further provides a method of testing the hardness of a material by impressing a penetrating tip into a surface of the material to be tested, the impressing force being dependent upon the force required to shear an accurately dimensioned control bar and being transmitted to the penetrating tip by a shearing member via the control bar until the control bar shears, and by measuring the resulting impression in the material, in which method the impressing force is further transmitted by a pin, one end of which is the penetrating tip and the other end of which abuts the control bar, and in which method the movement of the shearing member is damped after the control bar has been shared.

BRIEF DESCRIPTION OF THE DRAWING

Further features of the invention will become apparent from the following description of four preferred embodiments. The description refers to the accompanying drawing, in which:

FIG. 1 shows a sectional elevational view of a first embodiment of a durometer according to the present invention;

FIG. 2 shows a similar view of a second embodiment of a durometer according to the present invention;

FIG. 3 shows a similar view of a third embodiment of a durometer according to the invention; and

FIG. 4 shows a similar view of a fourth embodiment of a durometer according to the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring firstly to FIG. 1 of the accompanying drawings, a durometer comprises a susbstantially cylindrical casing **1**, of which the upper end **2** is flared as shown. A cylindrical shearing member **3** is disposed inside the casing **1**, the lower portion of shearing member **3** fitting snugly inside the lower portion of the casing **1**. The shearing member **3** is provided with a transverse hole in its lower portion, the hole extending completely through the shearing member **3**. A small control bar **4**, whose dimensions are accurately determined so that the control bar **4** will shear when a given force is applied transversely to it by shearing member **3**, is provided in the hole in the shearing member **3**. The shearing member **3** also has an axial hole in its lower portion which hole extends below the control bar **4** to the lower end of shearing member **3** and also above the control bar **4**. A pin **5** is provided in the axial hole, the upper end of the pin **5** abutting the control bar **4** and the lower end of the pin **5** constituting a penetrating tip **6**. The pin **5** is frictionally held in position in the axial hole in the shearing member **3** by means of a ball **7** urged against the pin by a spring **8**.

The shearing member **3** is provided at its upper end with a head **9** intended to receive an impact force, for example a hammer blow. When such an impact force, which may be uncontrolled so that the magnitude of the impact force may be different on different occasions when the durometer is used, is applied to the head **9**, the shearing member **3** will be urged downwardly and the uncontrolled impact force will be applied to the control bar **4**. If the impact force is greater than the force necessary to shear control bar **4**, the control bar **4** will shear and only the accurately known force necessary to shear the control bar **4** will be applied to pin **5** and to penetrating tip **6**.

In use, the durometer is placed in a surface on a material to be tested so that the bottom end of the casing **1** and the penetrating tip **6** contact the surface. When an uncontrolled impact force is applied to the head **9**, the penetrating tip **6** makes an impression in the surface due to the controlled force applied to the penetrating tip **6**, and the depth of the impression depends on the hardness of the material. The pin **5** may be made of small size and therefore low mass so that the inertia of the pin **5** will not significantly affect the depth of the impression in the surface of the material to be tested. Thus, an impression is formed which is substantially independent of the magnitude of the impact force applied to the head **9**.

The shearing member **3** is further provided, as shown in FIG. **1**, with a flared collar section **10**. Preferably, the surface of the flared section **10** and the inside surface of the flared section **2** of the casing **1** are substantially parallel. When the impact force is applied to the head **9** and the shearing member moves downwardly, the collar section **10** will become firmly wedged in the flared section of the casing **1**. Thus rebound of the shearing member and subsequent possible deformation of the impression formed in the material to be tested are avoided or substantially reduced.

Referring now to FIG. **2**, in which corresponding elements are numbered similarly to the embodiment of FIG. **1**, the casing **1** does not have a flared section and the shearing member **3** does not have a flared collar. Instead, in this embodiment, the damping means are constituted by a resilient annular member **12** fixed onto the lower face of the annular shoulder **11** of the shearing member **3**. In operation, damping is effected when the resilient member **12** strikes the upper face **13** of the casing **1**.

The embodiment of FIG. **3** is similar to the embodiment of FIG. **2**, except that in FIG. **3** the annular resilient member **12** is dispensed with. Instead, the durometer is provided with an annular resilient member **14** on the bottom of the casing **1**.

In the embodiment of FIG. **4**, the casing **1** is not provided and damping is effected by an annular resilient member **15** on the lower end of the shearing member **3**. In this embodiment, the stroke of the shearing member **3** is limited by the annular resilient member **15** striking the surface of the material to be tested.

It is to be understood that the embodiment particularly described above are illustrative and non limitative and that various modifications could be made without departing from the scope of the invention. For example, the casing **1** need not be cylindrical. The invention is defined in the appended claims.

I claim:

1. A durometer comprising an elongated shearing member provided in one end portion thereof with a first bore extending in longitudinal direction of the elongation of said shearing member and a second bore extending transverse to and intersecting said first bore; a control bar dimensioned to shear upon application of a predetermined force located in said second bore; a pin slidably arranged in said first bore and abutting with one end against said control bar and projecting with the other end, which constitutes a penetrating tip for making an impression in a material whose hardness has to be measured, beyond one end of said shearing member; and damping means located outside said first bore and serving in operation to absorb kinetic energy of said shearing member.

2. A durometer as defined in claim **1**, wherein said shearing member and said pin are cylindrical.

3. A durometer as defined in claim **1**, wherein the mass of said pin is only a fraction of that of said shearing member.

4. A durometer as defined in claim **1**, and including a casing having opposite open ends and peripherally surrounding said shearing member to slidably guide the latter for movement in longitudinal direction.

5. A durometer as defined in claim **4**, wherein said casing has at one end an outwardly flaring inner surface and said shearing member having at a corresponding end thereof an outwardly flaring outer surface, said flaring surfaces constituting said damping means.

6. A durometer as defined in claim **4**, wherein said shearing member has in the region of one end an annular shoulder having an end face spaced from and facing an end face at a corresponding end of said casing, said damping means comprising a resilient annular member on one of said end faces.

7. A durometer as defined in claim **4**, wherein said shearing member has in the region of one end an annular shoulder having an end face adapted to strike during operation a corresponding end face of said casing, said damping means comprising a resilient annular member applied to the opposite end face of said casing.

8. A durometer as defined in claim **1**, wherein said damping means comprises a resilient annular member applied to said one end of said shearing member.

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