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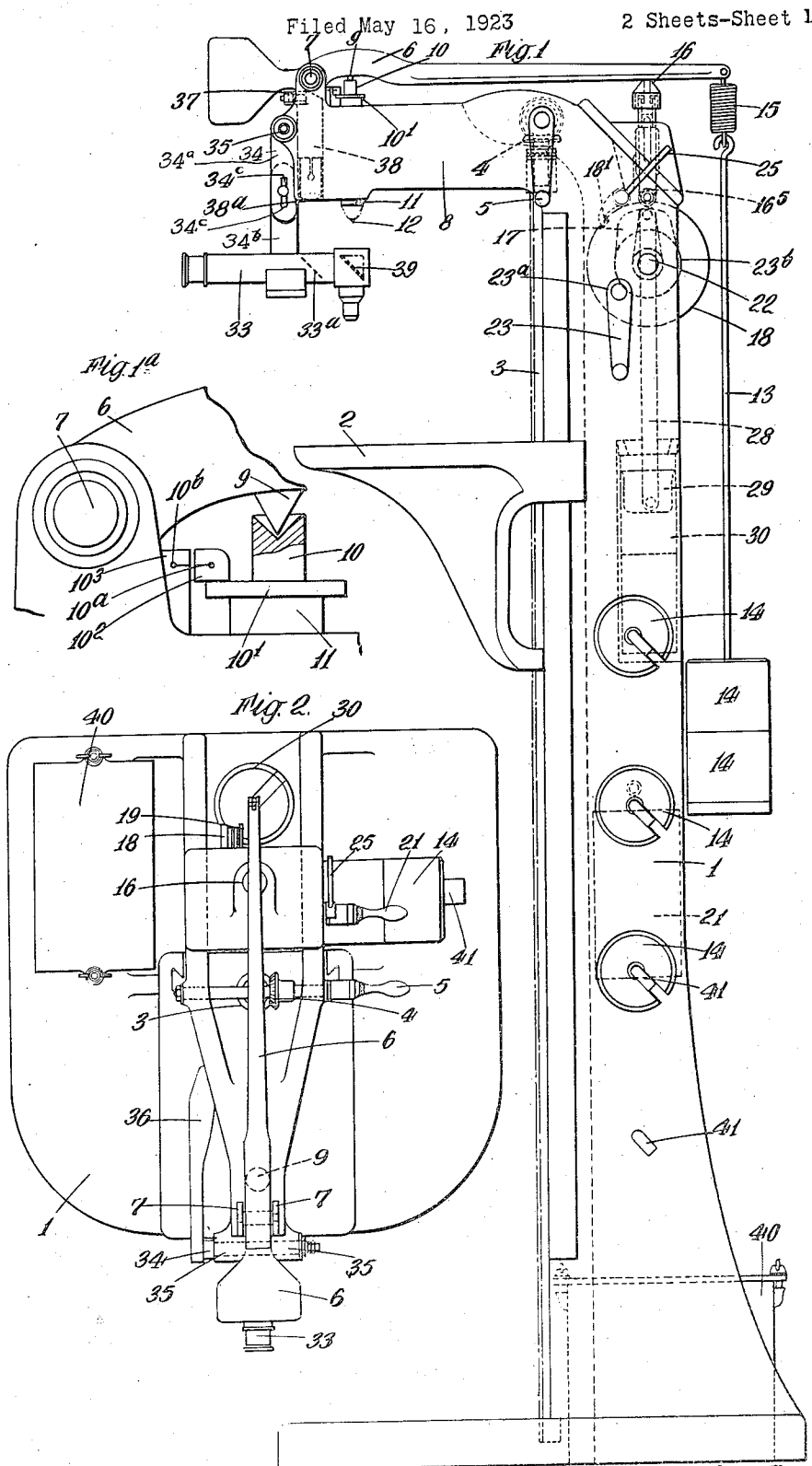
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R. L. SMITH ET AL

APPARATUS FOR TESTING THE HARDNESS OF MATERIALS

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2 Sheets-Sheet 1



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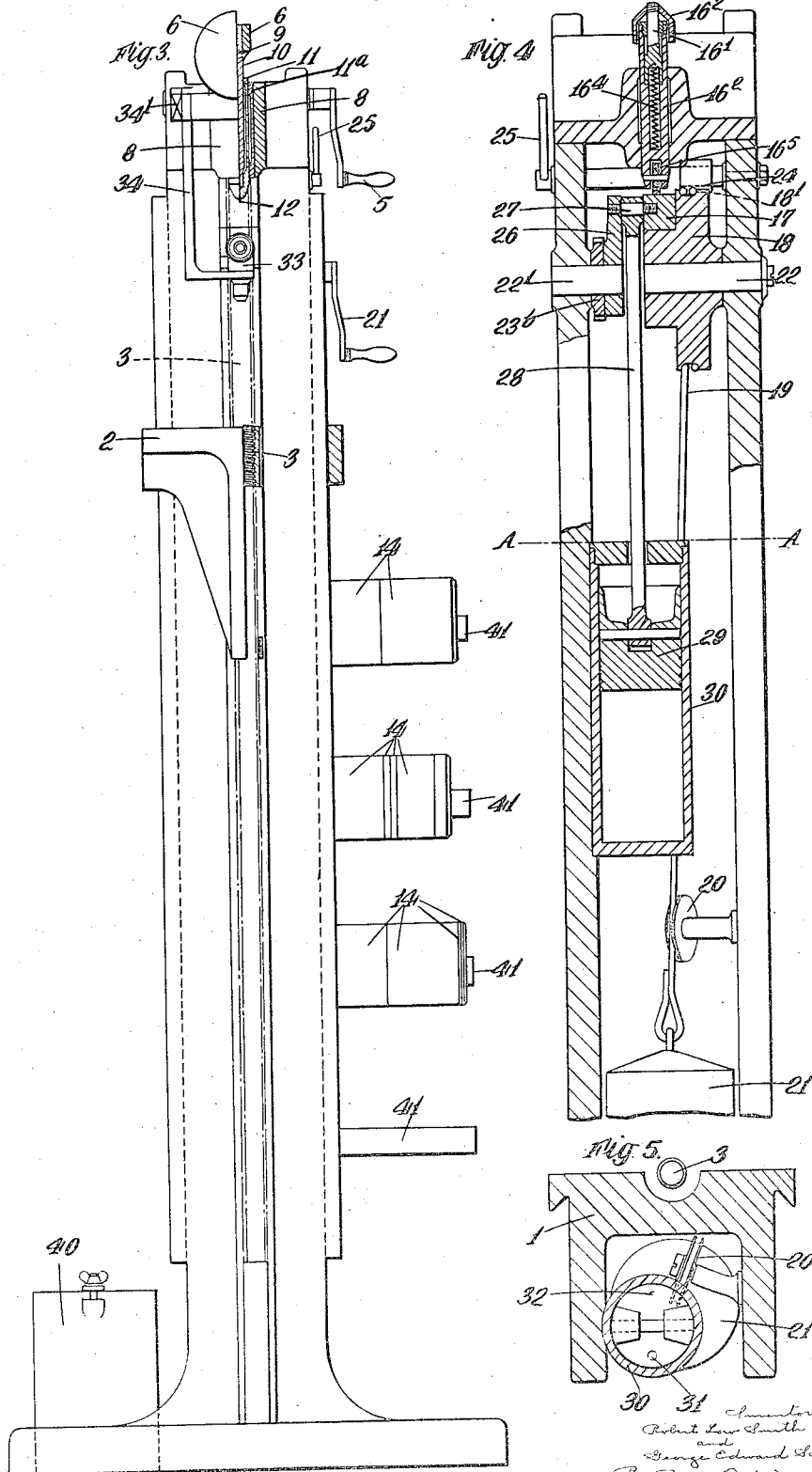
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UNITED STATES PATENT OFFICE.

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APPARATUS FOR TESTING THE HARDNESS OF MATERIALS.

Application filed May 16, 1923. Serial No. 639,229.

To all whom it may concern:

Be it known that we, ROBERT LOW SMITH and GEORGE EDWARD SANDLAND, both subjects of the King of Great Britain, residing at Erith Works, Erith, in the county of Kent, England, have invented certain new and useful Improvements in or Relating to Apparatus for Testing the Hardness of Materials, of which the following is a specification.

This invention relates to apparatus for testing the hardness of materials and more particularly to apparatus of the kind in which a definite load pressure is applied to the material to be tested by a member of small dimensions, the relative hardness of the material being gauged by measuring the size of the indentation made by the said small member in the material when a given weight is applied.

In apparatus of this kind it has been proposed to employ a rotatable cam or its equivalent for the purpose of applying pressure gradually to the material being tested, maintaining the pressure for a period of time and thereafter removing the same. In such apparatus, however, the time period which elapses before the load is removed has either not been determined automatically, and being under the control of the operator has therefore been a variable factor, or else in cases where the time period has been determined automatically the work or material to which the pressure is applied, has been moved upwards against the influence of the load so that the weights which apply the pressure must actually be lifted by the work.

According to the present invention we prefer to employ an apparatus in which the work or material which is being tested is supported upon a platform or table which is stationary during the application of the load, the pressure being applied gradually to the stationary material and, after the pressure has been maintained for a predetermined period of time, being automatically removed.

To this end we may provide a slidable rod or the like which is adapted to engage or to lie in the path of movement of a pressure applying lever which carries a weight at one end and acts upon the pressure applying member at its other end, together with a rotatable cam or its equivalent which

controls the reciprocating movement of the said rod in such manner that it is caused or permitted to move gradually out of the path of movement of the said lever so as to allow the latter to apply pressure to the work and which, after a predetermined interval of time, restores the weighted lever to its original position so as to remove automatically the pressure from the work.

The said cam may be adapted to be rotated by hand against the action of a counterweight to bring the aforesaid rod into position to restrain the movement of the weighted lever or the counterweight may be raised without rotating the cam, the latter being held in position by a pawl, so that, when released, the counterweight will effect the rotation of the cam, thereby permitting the rod to move out of the path of the said lever and thereafter restoring the rod to its initial starting position, the rotation of the cam being braked by a dashpot or its equivalent to ensure a suitable interval of time elapsing before the cam again restores the slidable rod to its initial position and removes the pressure of the lever from the work.

Although it has been proposed to employ a diamond in connection with other methods of testing the hardness of materials, we have discovered that in indentation tests in which the load is applied, maintained for a predetermined interval of time and thereafter automatically removed a diamond, either shaped, or uncut or natural, is the most suitable substance for making the impression or indentation in the work, but hardened steel or other hard material may be used in certain cases.

By means of the present invention we are able to ensure not only constancy of the time element both in the application and duration of the load, but also to eliminate inertia and to render possible the testing of intensely hard materials with a minimum of distortion or displacement so that the finished work is undamaged by the test. Moreover, and especially in cases where a diamond is employed, the impression or indentation made in the work is so small and the load applied is so light that very small objects may be tested. Consequently, and by means of the present apparatus the range of work is greatly increased, it being possible to subject to tests a variety of articles

entirely outside the capacity of apparatus using the ordinary ball test.

It will thus be seen that the present apparatus enables a novel method to be carried on for testing the hardness of materials said method consisting in supporting the work to be tested upon a platform or table which is stationary while the load is being applied, the pressure being thereafter applied gradually to the stationary work through the intermediary of a member of small dimensions and maintained for a predetermined period of time before being automatically removed.

In order that the said invention may be clearly understood and readily carried into effect the same will now be described more fully with reference to the accompanying drawings which show by way of example one embodiment of an apparatus constructed according to the present invention and in which:—

Figure 1 is a side elevation,

Figure 1^a is an enlarged view of a detail,

Figure 2 is a plan,

Figure 3 is a part sectional front elevation,

Figure 4 is a rear sectional elevation, and

Figure 5 is a section through the line A, A of Figure 4, the connecting rod being removed so as to show other parts more clearly.

1 is a main frame of the machine. 2 is the platform or table, upon which the work which is to be tested is supported, the platform 2 being mounted upon guides on the main frame of the machine and being free to move in a vertical direction under the influence of a screw threaded rod 3 adapted to be rotated through bevel gearing 4 by means of a handle 5 so that the platform may be raised and lowered on the said rod 3 as desired. 6 is the pressure applying lever which is pivoted between lugs 7, 7 on a horizontal arm 8 forming part of the main frame of the machine. The said lever 6 is provided towards its front end with a small projection or conical ended lug 9 constituted by a block of hardened steel inserted in a recess in the lever 6, the said projection 9 being adapted to bear, when the movement of the lever is unrestrained upon the upper end of a thrust rod 10, the lower end of which engages within a plunger 11, which is slidably mounted within a bearing 11^a in the arm 8 of the machine, the lower end of said plunger 11 carrying the member 12 of small dimensions for making the indentation or impression in the work. In the example shown the member 12 is constituted by a diamond, but hardened steel or other hard material may be used in certain cases. To the other end of the pressure applying lever 6 a rod 13 is connected to which suitable weights 14,

14 are adapted to be attached, a spring 15 being interposed as shown between the rod 13 and the lever 6. Mounted so as to have vertical reciprocating movement on the frame of the machine, is a rod 16, the upper end of which bears against the underside of the pressure applying lever 6 and holds the same so that the projection or lug 9 is raised slightly out of contact with the upper end of the thrust rod 10 when the same is raised to the position given by the indicator hereinafter referred to. In the example shown the rod 16 is constituted by an upper hardened steel portion 16¹ having a hood-like part 16² and a lower portion 16³, a buffer spring 16⁴ being provided and located in recesses in the parts 16¹ and 16². At the lower end of the part 16² a roller 16⁵ is provided which is adapted to run upon the surface of the rotatable cam 17 which latter is connected to or formed integral with a pulley wheel 18 around which a wire or cable 19 is wound, the free end of the cable passing over a guide roller 20 and being connected to a counterweight 21. In the example shown the periphery of the pulley wheel 18, is provided with a single tooth 18¹ and is rotatably mounted upon a spindle 22. Mounted upon a second spindle 22¹ is a part 26 which is connected to the cam 17 by means of a pin 27, so that the parts 17, 18, 26, 27, 22 and 22¹ form a crank-like arrangement. A handle 23 and gear wheels 23^a and 23^b are provided so that by rotating the handle 23 and consequently the pulley 18 the cam 17 can be brought into such position that the rod 16 is raised to its upper position, a pawl 24 pivotally mounted upon the frame of the machine and actuated by a handle 25 being adapted to engage with the ratchet tooth 18¹ on the pulley 18, so as to hold the cam 17 in the aforesaid position. It will thus be seen that the cam 17 will stop in one position only and the position of the ratchet tooth 18¹ is such that this occurs when the plunger 16 is supporting the lever 6 at its highest or normal position.

It will be understood that the primary object of the handle 23 and its associated gearing 23^a and 23^b is to raise the counterweight 21, and although in the example illustrated in the drawings the cam 17 is directly connected to the pulley 18, the parts could be so arranged as to permit the pulley to be rotated and the counterweight to be raised without moving the cam from its normal position. Connected to the pin 27 is the upper end of a rod 28 the lower end of which carries a piston or plunger 29 working within a cylinder 30. The piston and cylinder act as a dash-pot to brake the rotation of the cam 17, the cylinder 30 to this end being filled with a fluid such as oil and

the piston 29 being provided with a needle valve 31 and a non-return valve 32. In view of this arrangement and when the parts are in the raised position shown, the disengagement of the pawl 24 by means of the handle 25 will release the cam 17, while the piston and cylinder 29 and 30 will act as a dash-pot so as to brake the movement of the same. As the cam 17 rotates the rod 16 is gradually permitted to move downwards away from the lever 6 so that the projection 9 bears upon the upper end of the plunger 10 and pressure is transmitted through the diamond 12 to the work. The shape of the cam ensures the pressure on the work being maintained for a predetermined interval and the arrangement of the parts is such that when the cam 17 has completed a full rotation the rod 16 has again been raised to normal position and the pressure exerted through the lever 6, conical ended lug 9 and plunger 10 is automatically removed.

Referring more particularly to Figure 1^a, 10¹ is a ring provided at the upper end of the plunger 11 which is adapted to carry a member 10² having a notch 10^a forming part of an indicator for indicating the correct height of the diamond holder or plunger 11. 10³ is the other member of the indicator which is similarly provided with a notch 10^b and carried either by the lugs 7, 7 or by the part 8. In carrying out a test the work is placed upon the platform 2, which is raised until contact is made with the diamond 12. When the stage or platform 2 is raised still further the diamond 12 with its holder or plunger 11 and thrust rod 10 are also lifted until the lines 10^a and 10^b of the indicator coincide. The lug 9 in this position of the parts is just clear of its seating on the plunger 10.

For the purpose of facilitating inspection of the indentation or impression made by the diamond a microscope 33 is provided carried by an arm 34 pivotally attached at 35 to the face of the arm 8, a spring 36 being also provided so that the arm 34 which carries the microscope 33 can be held in one or other of the two required positions. To this end the arm 34 has a projection or lug 34¹ at its upper end upon which two flats, cams, or their equivalent are provided, the spring 36 normally bearing upon the uppermost of these cams, thus serving to restrain the rotation of the arm 34 and locking the microscope in its upper or lower position, as desired. The arm 34 which carries the microscope 33 may, if desired, be made in two parts 34^a and 34^b, each formed with an elongated slot 34^c, the parts being held together by a screw 34^d so that by loosening the screw 34^d the parts 34^a and 34^b can be moved relatively to each other for purposes of fine adjustment, while coarse adjustment can be effected by moving the platform 2 by means of the adjusting screw 3. An electric lamp 37 is provided and located in a socket or housing 38 in the arm 8 of the machine, the lamp being provided to facilitate examination by the microscope 33. The light of the lamp 37 is directed through a lens 38^a on to the usual clear glass reflector 33^a in the microscope 33 and thence to a reflecting prism 39. An accumulator battery or other source of electric current 40 may be provided and supported as shown on the bed plate of the machine. Laterally projecting lugs 41, 41 may also be provided on the arm of the machine for accommodating the weights 14 so that the whole machine forms a portable unit.

What we claim and desire to secure by Letters Patent of the United States is:—

1. Apparatus for testing the hardness of materials comprising a pressure applying lever, a weight at one end of said lever, a pressure applying member near the other end of said lever, a slidable member adapted to lie in the path of movement of said pressure applying lever, means controlling the movement of said slidable member and causing the same to move automatically and gradually out of the path of movement of said pressure applying lever to allow the latter, through the intermediary of the pressure applying member, to apply pressure gradually to the work and means acting automatically to restore the pressure applying lever to its original position, after the lapse of a predetermined interval of time, and to remove the pressure from the work.

2. Apparatus for testing the hardness of materials comprising a weighted pressure applying lever adapted to apply pressure to the work, a counterweight, a slidable member subjected to the influence of the counterweight, a cam member controlling said slidable member, means for releasing said counterweight, and means controlled by said counterweight for effecting the rotation of said cam and permitting said slidable member to move out of the path of the pressure applying lever to allow pressure to be applied to the work and automatically restoring said member to its initial position after a predetermined interval of time so as to remove the pressure from the work.

3. Apparatus for testing the hardness of materials comprising a weighted pressure applying lever, a slidable restraining member, cam means controlling said restraining member, a counterweight, means for releasing said counterweight, means controlled by said counterweight for effecting the rotation of said cam means and permitting said slidable member to move out of the path of said pressure applying lever to allow pressure to be applied to the work and thereafter restoring said member to its initial

position so as to remove the pressure from the work, and a delay action device controlling the speed of rotation of said cam member and ensuring the lapse of a suitable interval of time before the cam means restore the restraining member to its initial position.

4. An apparatus for testing the hardness of materials comprising a member adapted to make an indentation in the material, a lever cooperating with the indentation forming member and adapted to cause pressure to be brought to bear thereon and thereby effect its movement in one direction, and means for automatically removing the pressure from the lever after a predetermined interval of time.

5. An apparatus for testing the hardness of materials comprising a member adapted to make an indentation in the material, a lever cooperating with said member to cause pressure to be brought to bear thereon, a second member cooperating with the lever and means for automatically raising and lowering said second member at predetermined intervals, whereby the duration of the pressure on the indentation member is automatically controlled.

6. An apparatus for testing the hardness of materials comprising a member adapted to make an indentation in the material, a lever cooperating with said member to cause pressure to be brought to bear thereon, a second member coacting with said lever, and

means for actuating said second member whereby the duration of pressure on the indentation member is automatically regulated.

7. An apparatus for testing the hardness of materials comprising a member adapted to make an indentation in the material, a lever cooperating with said member to cause pressure to be brought to bear thereon, a second member engaging said lever and adapted to raise and lower it, whereby the duration of pressure upon the indentation member is controlled, and cam means for automatically raising and lowering said second member at predetermined intervals of time.

8. An apparatus for testing the hardness of materials comprising a main frame, a work-supporting platform carried thereon, an indentation forming member reciprocally mounted in said main frame, a lever pivoted to the main frame and having a portion thereof coacting with the indentation forming member to cause its reciprocation in one direction, said lever having a counterweight at one end thereof and a pressure applying weight at its other end, and means between the pressure applying weight and the indentation forming member for automatically controlling the duration of the pressure on the indentation forming member.

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