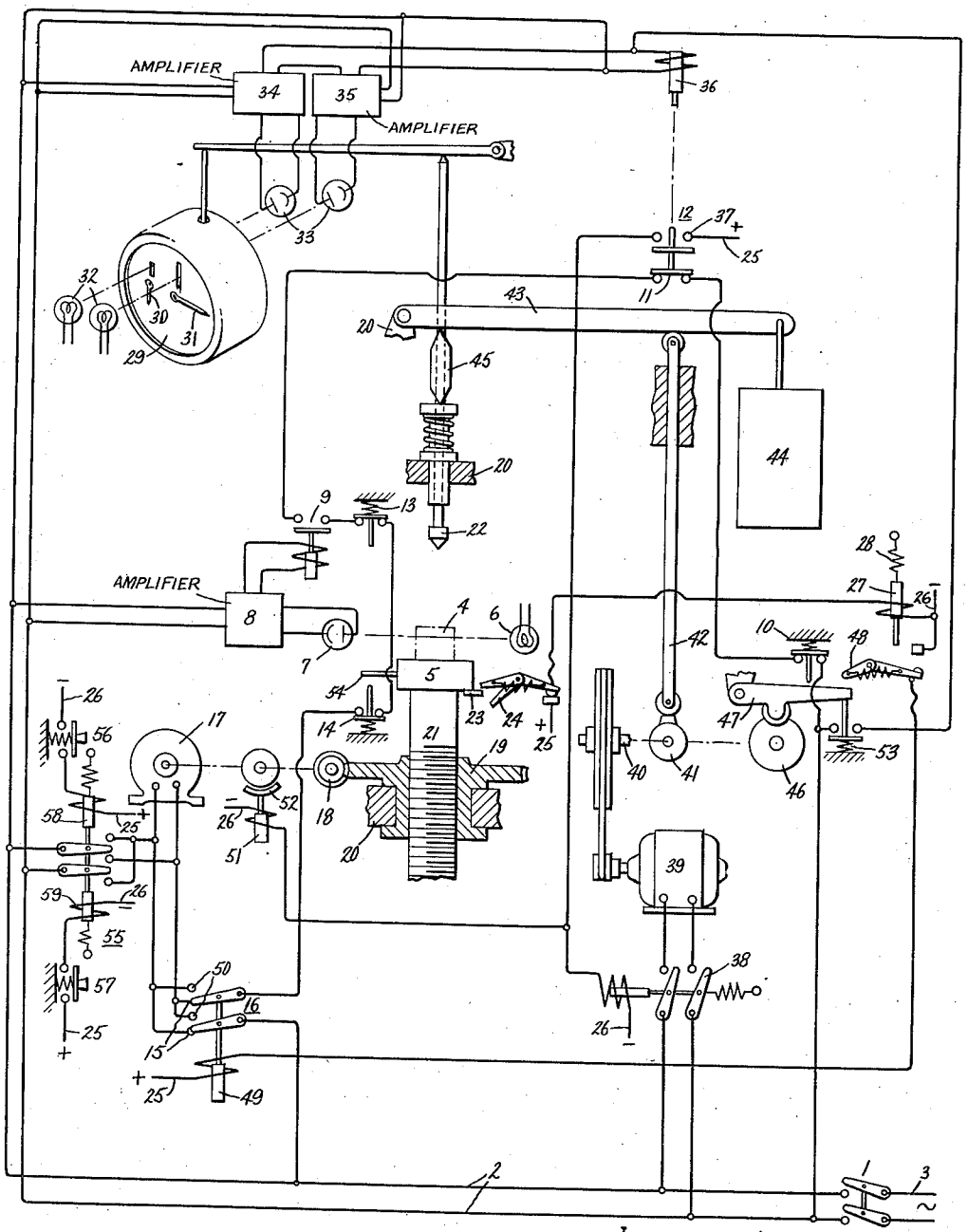
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AUTOMATIC HARDNESS TESTER

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AUTOMATIC HARDNESS TESTER

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Our invention relates to improvements in hardness testing machines for effecting the automatic operation of one variety thereof.

To obtain the hardness number of a test specimen on one form of hardness testing machine as presently constructed, the specimen is placed upon the platform of the machine. The machine is manually operated to raise the specimen to the penetrator or brale and continued to be operated to zero two indicator needles pivoted upon a dial of the machine. A handwheel is then operated to set the dial to zero.

Another manual operation of the machine applies the major load to the specimen. When the hardness number is indicated by one of the indicator needles, the platform is lowered and the specimen is removed.

The object of our invention is to provide apparatus to make a hardness testing machine automatic so that the operator need only place the specimen upon the platform and remove it after the hardness is recorded by the needle.

According to our invention, a motor is provided to drive the platform of the testing machine. When a specimen is placed upon the platform, an electric eye switch starts the motor, which continues to run as the specimen contacts the brale and until the dials are simultaneously zeroed. The motor is stopped by electric eye switches acting in combination with a solenoid switch having a pair of contacts, one of which breaks the contact to the drive motor. The other contact energizes a solenoid brake on the motor and operates a switch energizing a motor to apply the major load to the workpiece.

A pair of snap switches operated by the platform and by a lever controlled by the load motor energize a solenoid control operating a reversing switch of the drive motor. Another switch is controlled by application of the major load by the load motor to de-energize the drive motor while the major load is being applied.

The platform is provided with limit switches to disconnect the drive motor in case of overdrive of the platform while a solenoid operated spring centered switch controlled by push buttons energizes the drive motor for opposite drive when either limit switch is opened.

Reference is made to the accompanying drawing, the single figure of which is a schematic view of an embodiment of our invention.

According to the drawing, switch 1 connects leads 2 to a source of electric power 3. When switch 1 is closed, the specimen 4 is placed upon a platform and interrupts a beam of light between light source 6 and a photoelectric cell 7. The signal from cell 7 passes through amplifier 8 to complete the circuit from leads 2 to close solenoid switch 9 completing a circuit from leads 2 through switch 10, contacts 11 of switch 12, limit switches 13 and 14 and contacts 15 of reversing switch 16 through motor 17 to leads 2 thereby operating motor 17. A worm 18 mounted upon the shaft of motor 17 meshes with a gear 19 rotating upon frame 20 of the machine and provided with an axial bore threaded to raise or lower screw 21 upon which platform 5 is mounted. When contacts 15 of switch 16 are closed, motor 17 operates in the direction to raise workpiece 4 to meet penetrator or brale 22.

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As platform 5 is raised, an extension 23 of platform 5 operates a snap switch 24 to open the connection between a source of power 25 and 26 and de-energize solenoid 27 allowing it to be withdrawn by spring 28. Motor 17 continues to raise platform 4 to engage brale 22 to impose a minor load upon specimen 4. The machine is provided with an indicator dial 29 upon which are pivotally mounted two indicator needles 30 and 31 connected by a lever system to brale 22.

Motor 17 drives platform 5 upward until indicators 30 and 31 simultaneously arrive at zero position indicating that the minor load is bearing upon workpiece 4. Slits are provided in dial 29 behind the zero positions of the needles 30 and 31, and light sources 32 are focused through the slits upon photoelectric cells 33. These cells are connected to amplifiers 34 and 35, the outputs of which are connected in series in a circuit between a solenoid 36 operating switch 12 and leads 2 so that when the light beams from source 32 are interrupted by needles 30 and 31, simultaneously the circuit is closed energizing solenoid 36 to operate switch 12. As switch 12 is operated, contacts 37 are closed to energize a circuit between power source 25 and 26, energizing solenoid switch 38 to operate motor 39. Motor 39 is belt connected to a shaft 40 upon which is mounted a cam 41. In the position shown, cam follower 42 of cam 41 supports a lever 43 pivoted at one end upon frame 20 and from the opposite end of which a weight 44 is suspended. As motor 39 rotates cam 41, lever 43 lowers allowing the major load to be applied to specimen 4 through lever 43 and a member 45 bearing upon brale 22.

A cam 46 is also mounted upon shaft 40 operating a follower arm 47 and designed to raise arm 47, during the time the major load is applied, to operate switch 10 interrupting the circuit between leads 2 and motor 17. As arm 47 rises, it

operates a snap switch 48 to complete a circuit between source 25, 26 through solenoid 49 actuating solenoid 49 to close contacts 50 of switch 16 reversing the polarity of motor 17 in readiness for the return of platform 5 to its original position.

When contacts 37 of switch 12 are closed, a circuit is completed between source 25 and 26 through solenoid 51 operating motor brake 52 to stop motor 17. During a single revolution of cam 41, follower 42 is lowered from the position shown to allow the major load to be aplied to workpiece 4 and is returned to the original position. During this time, indicator needle 31 records the hardness number of the specimen upon dial 29.

When indicator needle 31 leaves the zero position to indicate the hardness number, connection to solenoid 36 from line 2 is interrupted. A circuit is provided energized by switch 53 operated by arm 47 to hold solenoid 36 energized while the major load is applied to specimen 4. There is no discontinuity between the time solenoid 36 is energized through amplifiers 35 and 34 and through switch 53 since there is a time lag between the starting of motor 39 and the movement from zero of needles 30 and 31 due to cam 41.

When the major load is removed by cam 41, arm 47 drops to open switch 53 and de-energizes solenoid 36. With solenoid 36 de-energized, switch 12 operates closing contacts 11 in the circuit of motor 17 and opening contact 37 releasing brake 52 and disconnecting load motor 39. When follower 42 returns to its original position removing the major load from specimen 4, arm 47 drops back allowing contact to be made in switch 10 completing the circuit to motor 17 which operates to drive platform 5 down to its original position.

As platform 5 descends, projection 23 operates switch 24 to close contact between source 25, 26 through solenoid 27 to energize solenoid 27 causing it to actuate snap switch 48 opening the circuit between source 25, 26 through solenoid 49, de-energizing solenoid 49 to allow switch 16 to close contacts 15 again reversing the polarity of motor 17 to prepare it again to move table 5 upward. A projection 54 upon platform 5 operates limit switches 13 or 14 to disconnect motor 17 if for any reason motor 17 continues to drive platform 5 beyond the desired upward or downward travel. A spring centered switch 55 connects the leads of motor 17 to leads 2 and is operated by push buttons 56 and 57 operating solenoids 58 and 59, respectively, to reverse motor 17 if it should be disconnected by limit switches 13 and 14.

While certain specific embodiments have been shown and described, it will, of course, be understood that various modifications may be made without departing from the invention. The appended claims are, therefore, intended to cover any such modifications within the true spirit and scope of the invention.

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

1. In combination, a hardness testing machine including a platform to support a test specimen, means for elevating and lowering said platform, a penetrator device for applying load to said specimen, means for loading said penetrator device and a device for indicating penetration of said specimen, said indicating device including a dial and an indicator needle pivoted upon said dial, and control means comprising motor means

driving said elevating means connected to a source of electric power, photoelectric switch means responsive to the presence of a specimen upon said platform to energize said drive motor, an electromagnetically operated multiple switch means responsive to the positions of said needle to energize and de-energize the electromagnet of said multiple switch, an electromagnetic brake mounted upon said motor, means controlling said loading means, contacts mounted upon said multiple switch to energize said controlling means and said brake in response to arrival of said needle at zero position, electromagnetic reversing means controlling said drive motor, control means connected to said reversing means responsive to operation of said loading means to energize said reversing means and responsive to a limiting movement of said platform to de-energize said reversing means, limit switches controlling said drive motor responsive to travel of said platform to disconnect said drive motor at the ends of travel of said platform, separate reversing means controlling said drive motor and manual switch means controlling said reversing means to reverse the direction of travel of said motor when de-energized by said limit switches.

2. In combination, a hardness testing machine having a platform to support a test specimen, means for elevating and lowering said platform, a penetrator device for applying a load to said specimen, means for loading said penetrator device, means for indicating the amount of penetration of said penetrator into said specimen including a dial and a pair of indicator needles pivoted upon said dial, said dial having a pair of slits therein positioned at the zero position of said needles, control means for said machine comprising motor means for operating said elevating and lowering means, means for controlling said motor means including a photoelectric switch, said photoelectric switch being energized when a test specimen is placed on said platform, a solenoid operated multiple switch having pairs of contacts, switching means controlling said multiple switch according to the position of said needles upon said dial, a solenoid load switch controlling said loading means, a solenoid operated brake mounted upon said elevating motor, one of said contacts closing to energize the solenoids of said brake and said load switch in response to simultaneous zeroing of said needles, means for reversing said elevating motor means, a pair of snap switches one of which is responsive to the position of said platform, the other of which is responsive to application of load by said loading means controlling said reversing means, a pair of limit switches responsive to overtravel of said platform controlling said elevating motor, separate reversing means controlling said elevating motor, and switches controlling said separate means for operation of said elevating motor after operation of said limit switches.

3. In combination, a hardness testing machine having a platform to support a test specimen, means for elevating and lowering said platform, a penetrator device for applying load to said specimen, means for loading said penetrator device and a device for indicating the amount of penetration in the specimen of said penetrator, said indicating device including a dial and a pair of indicator needles pivoted upon said dial and control means for said machine comprising motor means for driving said elevating means connected to a source of electric power, photoelectric switch

means responsive to the placing of a test specimen on said platform for energizing said drive motor, an electro-magnetically operated multiple switch, a pair of photoelectric cells in series with the solenoid of said multiple switch and responsive to zero position of said needles to energize and de-energize upon the shaft of said motor, solenoid operated loading switch controlling said loading means, contacts mounted upon said multiple switch for energizing said loading switch with said needles in zero position, a spring biased switch to energize the solenoid of said multiple switch in response to application of said load, switching contacts mounted upon said multiple switch disconnecting said drive motor when said load is applied, a solenoid operated reversing switch controlling the direction of operation of said drive motor, a first snap switch controlling the solenoid of said reversing switch, said first snap switch being responsive to application of load to said specimen to actuate the solenoid of said reversing switch, a solenoid positioned to operate said first snap switch, a second snap

switch responsive to position of said platform to energize said solenoid when said platform is lowered, limit switches controlling said drive motor positioned at the ends of travel of said platform, separate reversing means controlling said drive motor and button switches controlling said reversing means to reverse the direction of travel of said platform when said motor is de-energized by said limit switches.

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