Dec. 6, 1938. A. SONNTAG 2,139,527

IMPACT TESTING MACHINE

Filed Dec. 9, 1935 3 Sheets-Sheet 1

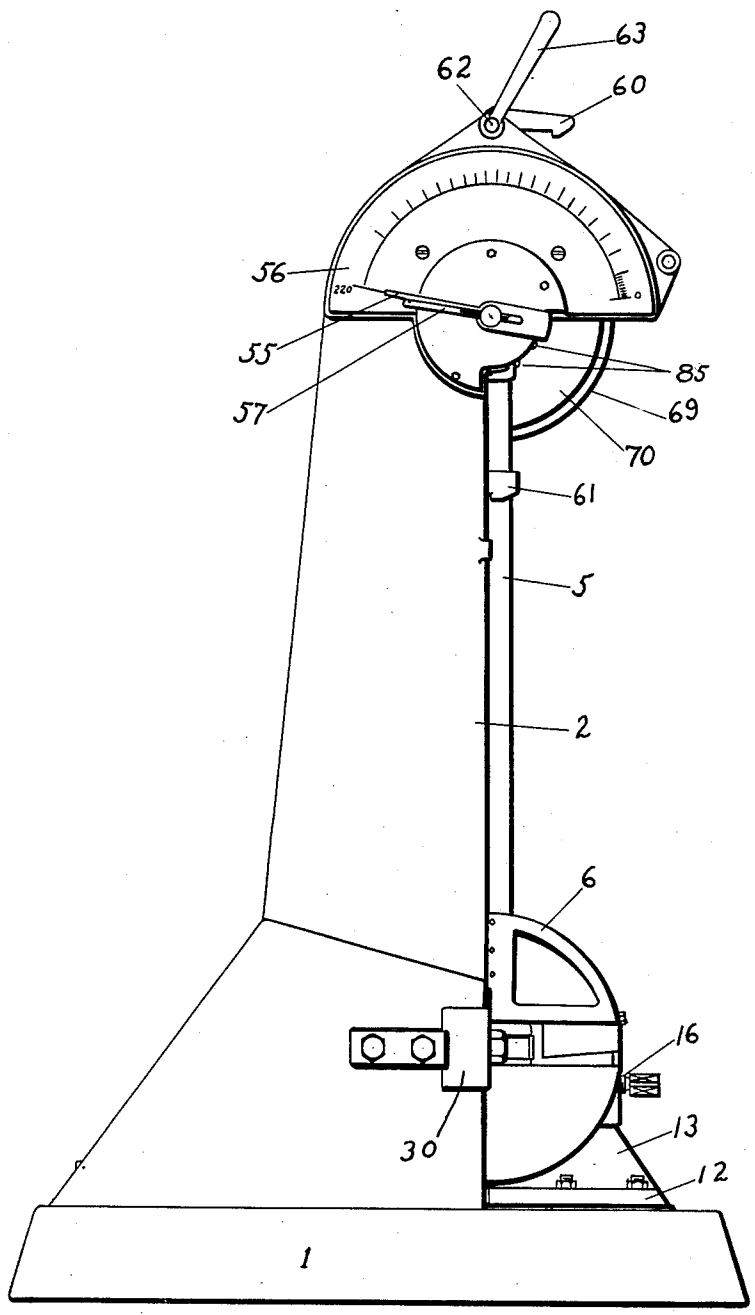


Fig. 1.

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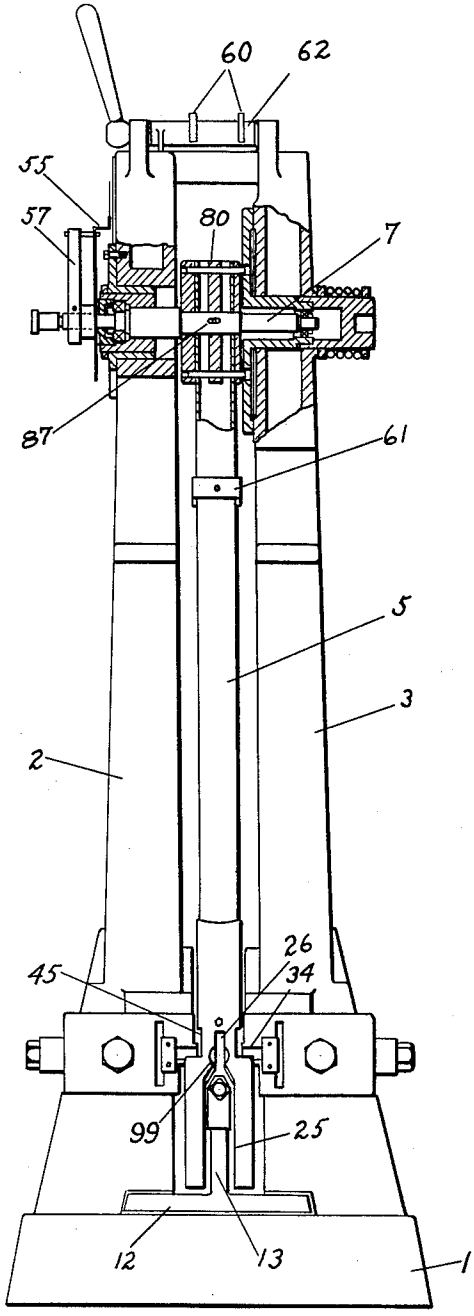


Fig. 2.

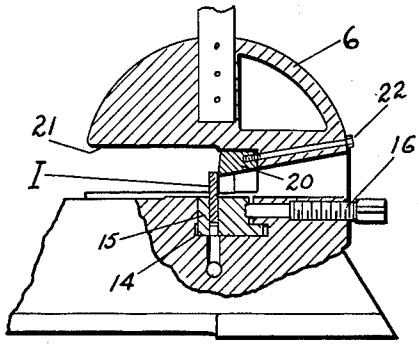


Fig. 3.

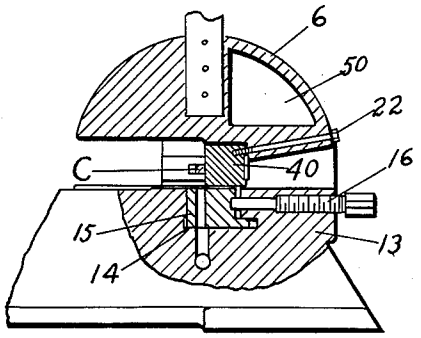


Fig. 4.

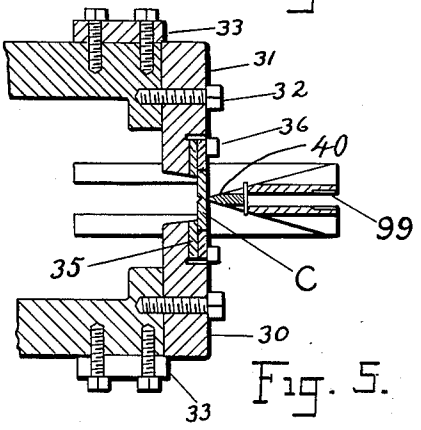


Fig. 5.

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IMPACT TESTING MACHINE

Filed Dec. 9, 1935 3 Sheets-Sheet 3

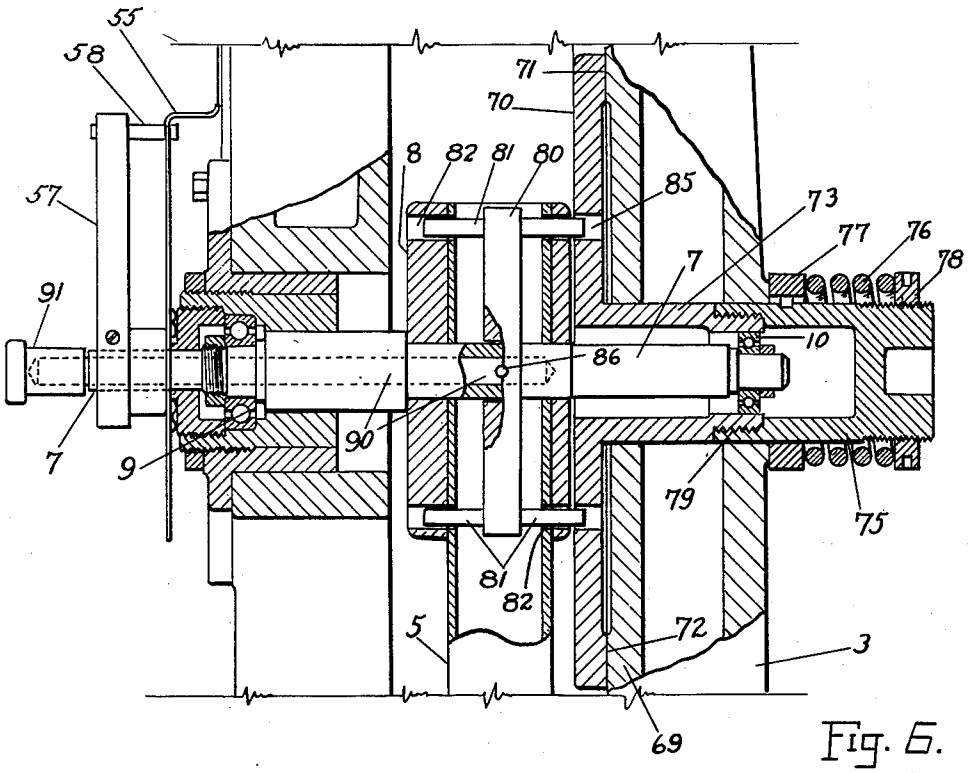


Fig. 6.

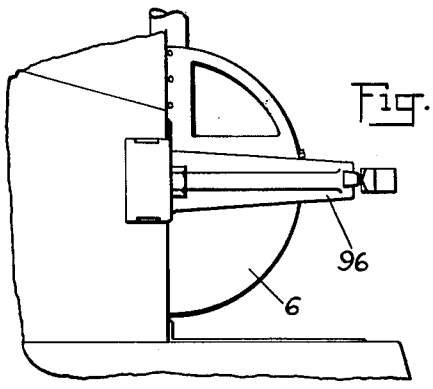


Fig. 7.

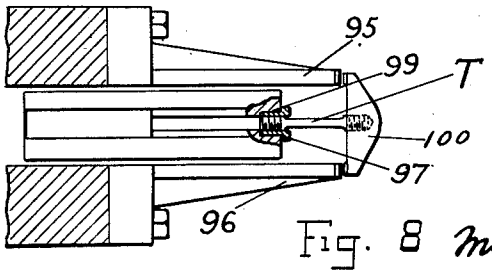


Fig. 8

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Patented Dec. 6, 1938 2,139,527

UNITED STATES PATENT OFFICE

2,139,527

IMPACT TESTING MACHINE

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Application December 9, 1935, Serial No. 53,451

4 Claims. (Cl. 265—13)

The invention relates to impact-testing mechanism and more especially to a novel and useful mechanism for performing both Izod and Charpy impact tests.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, constructions, arrangements, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate one embodiment of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

Fig. 1 is a side elevation of a mechanism embodying the invention;

Fig. 2 is a front elevation of the mechanism shown in Fig. 1, certain parts being shown in section;

Fig. 3 is a fragmentary sectioned detail of the pendulum bob and specimen support arranged for making the Izod test;

Fig. 4 is a view similar to Fig. 3 with the mechanism arranged for making a Charpy test;

Fig. 5 is a central horizontal section of the mechanism shown in Fig. 4 on an enlarged scale;

Fig. 6 is an enlarged fragmentary view of the sectioned portion of Fig. 2, showing the pendulum support and braking mechanism in detail;

Fig. 7 is a fragmentary side elevation of the pendulum mechanism in position for making a tension test; and

Fig. 8 is a plan view of the mechanism shown in Fig. 7.

The invention is directed to providing a mechanism for performing several types of impact tests wherein the resistance of a specimen to breaking under sudden impact is measured by the terminal travel of a pendulum hammer after the breakage of the specimen. Several types of such tests are known, involving somewhat different technique and using arbitrarily chosen standards and specimens. The principal known impact-testing systems and machines are used in making the so-called Izod tests and the Charpy tests, both of which utilize a pendulum impacting device such as described above. A similar device is also used for ascertaining the strength in tension of specimens under impact.

The present invention provides a new and useful testing mechanism which is adapted to perform Izod, Charpy and tension tests, all with great accuracy and efficiency and with a minimum of changing and re-setting of parts of the machine, avoiding loss of time and sacrifices in the accuracy of any of the tests. One object of the invention is to provide a single pendulum of simple mechanical construction which is adapted to make all three types of tests without change of the pendulum or even of the pendulum bob. Furthermore the mechanism is adapted to remain in condition at all times to perform at least two of the tests and the pendulum bob is designed to avoid interfering with or being obstructed by any of the devices used in making any of the tests. The invention provides a single unitary pendulum and bob for making all of said tests and requires only the interchange of the particular knife or specimen fracturing edge which is to be used with the specimen peculiar to the particular test.

Another object of the invention is to provide a pendulum so constructed that it will always strike the specimen at the true center of gravity of the pendulum, thus avoiding any tendency to vibrate or cause impact to occur at an incorrect point in the swing. For this purpose the pendulum bob is especially designed to compensate for the various clearances and shapings provided to impart its universal applicability to the several tests.

The invention further provides an improved braking mechanism for selectively controlling the damping or slowing down and stopping of the pendulum after completion of the test. The invention provides a very simple, efficient and strong braking device which forms an integral part of the pendulum frame and acts directly on the pendulum axis, thereby avoiding external application of braking friction and making for simplicity and strength of design. Thus undesired wear on the pendulum bob is avoided and the brake-operating means are in a readily available location.

Broadly described, the mechanism of the invention comprises a strong and compact frame for rotatably supporting the pendulum and having means for supporting the Izod and Charpy specimens at the bottom of the pendulum swing. The pendulum bob is bifurcated to clear the centrally disposed Izod-specimen anvil and support and is narrowed and cut away on its lateral faces to clear the inwardly projecting ends of the Charpy-specimen anvils and supports. The bob is provided with a suitable knife-supporting seat which is adapted to hold interchangeably either the

Charpy knife or the Izod knife and said bob is provided with a knife clamping member which cooperates with either form of knife. Thus the only change required for making either test is simple replacement of the knife in the bob, which change requires less than one minute. The bob is also bored to receive suitable tension specimens and same can be applied to the bob with no greater changes or delays than required for the other types of tests.

It will be understood that the foregoing general description and the following detailed description as well are exemplary and explanatory of the invention but are not restrictive thereof.

Referring now in detail to the present preferred embodiment of the invention illustrated by way of example in the accompanying drawings, the mechanism comprises a main frame of cast metal having a relatively heavy and large rectangular base 1 and two spaced-apart legs or standards 2 and 3. The lower parts of the legs are sloped downwardly and outwardly to join the base, thereby giving additional rigidity and stability to the frame, while the upper ends of the two legs are suitably curved and enlarged to provide for indicating mechanism and to rotatably support the pendulum as will be hereinafter described.

The invention provides a specimen-breaking hammer in the form of a pendulum comprising the relatively long, hollow rod 5 with the bob 6 rigidly attached to the lower end of the rod. The pendulum is mounted near the upper end of the rod to swing freely between the spaced apart legs 2 and 3 of the frame, the upper portion of the rod being fixed to rotate with horizontally disposed shaft or axle 7 by means of a casting 8 which is bored to receive and hold the rod and is also transversely bored and rigidly fixed to the shaft 7. The horizontal shaft 7 is journalled to rotate freely in the legs 2 and 3, being supported in the leg 2 by the ball bearing 9 and in leg 3 by the ball bearing 10. As will be clear from Figure 1 the axis of rotation of the pendulum is such that the center of the bob 6 normally lies adjacent the flat vertical faces of the legs 2 and 3 when the pendulum hangs freely stationary.

Referring now to the embodied means for enabling the mechanism to function as both an Izod and a Charpy tester, the base 1 of the machine is provided with a suitable T-shaped block for positioning and holding the Izod specimen anvil. The base 12 of the block is suitably bolted to the upper face of the machine base 1 so that the relatively long and narrow, upstanding rib 13 of the block is centrally disposed with respect to the space between the legs 2 and 3 and thus is bisected by the plane of rotation of the pendulum. A suitable recess 14 is provided in the upper face of the rib 13 to receive the Izod anvil 15, which is seated and held in position by a grip screw 16 which is suitably threaded into the rib 13 (Fig. 3) and can be operated from the front of the machine. An Izod specimen I is shown in testing position in Fig. 3.

The pendulum bob 6 is provided with means for supporting an Izod knife or striking edge in proper position with respect to the pendulum and the specimen. As shown (Fig. 3) the knife 20, of hardened tool steel is removably seated at the interior of the bob so that the forward or striking edge of the knife lies exactly in the plane of the axis of the pendulum and contacts the face of the specimen I in the vertical plane, so that the impact is made just as the pendulum is crossing through the nadir of its swing. It will be noted that the bob 6 is cut away to form a substantial slot or window 21 extending horizontally from the leading edge of the bob to beyond the center thereof whereby the bob clears the specimen I until contact is made by the knife. The knife is removably seated against the top and rear edges of the slot 21 and is held in position by the screw bolt 22 which enters through the radial bore in the trailing face of the bob.

The bob is shaped so that it will clear the anvil block 13 during its entire swing and accordingly the lower portion of the bob is bifurcated at 25 to straddle the block 13, the upper portion of the slot 25 being narrowed and extended at 26 to provide clearance for the specimen.

Referring now to the embodied means for utilizing the mechanism for Charpy tests, Charpy anvil blocks 30 and 31 are seated in suitable horizontal recesses in the vertical front faces of the legs 2 and 3 and held in position as by bolts 32 and overlapping end blocks 33. The blocks 30 and 31 are provided with suitable horizontal grooves 34 in which the transversely disposed Charpy specimen C may be supported. Suitable anvils 35 are seated within the slots 34 against the rear faces thereof, while bridging plates or guards 36 are provided as shown.

The knife or striking edge for the Charpy tests comprises a wedge shaped member 40 of hardened tool steel having its leading edge in the vertical plane (Figs. 4 and 5) at the moment of impact. The knife 40 is removably seated in the bob in substantially the same manner as the Izod knife 20, being held in the upper rear corner of the slot 21 by the bolt 22 as hereinbefore described. The leading edge of the knife 40 also lies in the axis of the pendulum so that impact occurs at the nadir of the swing.

The disc-shaped bob 6 is likewise constructed so that it will clear the ends of the inwardly projecting Charpy anvil blocks 30 and 31 in its swing. For this purpose the upper portion of the bob 6 is of narrowed cross section, that is above the bottom of the horizontal slot 21. In addition the lateral faces of the bob disc are recessed at 45 to provide clearance for the inner ends of the Charpy blocks 30 and 31 and anvils 35.

From the foregoing description it will be clear that to adapt the device for functioning either as an Izod or a Charpy testing mechanism, it is merely necessary to unscrew the bolt 22 and release the Izod knife, for example, and replace it with the Charpy knife or vice versa. No other change in the mechanism is necessary and the machine is ready for the test simply by seating the appropriate specimen in its anvil.

The bob is suitably constructed to give proper weight distribution and assure that the center of percussion or oscillation conforms exactly with the center of the striking edge of the knife. To assure this proper distribution of weight and location of center of gravity of the pendulum, the bob disc is suitably cut away at 50 in the upper, right hand quadrant so as to compensate for the weight-distribution distortion caused by the various other slots and irregularities in the disc. The bob construction and the shape and arrangement of the knives are so designed that the weight of the striking edges as well as their center of gravities in three directions are brought to coincide with each other very accurately and also there is no change in the weight, balance and center of percussion of the pendulum hammer

as a whole when working with either the Izod or Charpy striking edge.

The invention provides suitable means for indicating the maximum height of swing of the pendulum after break of the specimen, said indicating means being suitably graduated to show the amount of energy consumed by the breaking of the specimen. As is usual in impact testing devices of the Izod and/or Charpy type, the pendulum is released from a predetermined starting position, fractures the specimen at the nadir of its arc and then swings up on the reverse side until the unconsumed energy is expended. The difference in height between the initial and reverse side positions of the bob is the measure of the energy consumed and means are provided for indicating said difference. As embodied, a pointer 55 is provided to rotate about the axis of the pendulum shaft, the pointer being pushed ahead during the reverse swing of the pendulum and is adapted to remain in the maximum reverse position as the bob falls. A suitable arcuate scale 56 is provided beneath the pointer on the curved upper end of the leg 2. The embodied means for moving the pointer on the reverse swing of the pendulum comprises an arm 57 fixed to and extending radially from the projecting end of shaft 7 and having an inwardly projecting pin 58 which lies in the path of movement of the pointer 55. The pointer itself is mounted to turn independently about the shaft 7 with a slight friction so that it will be advanced by the arm 57 on reverse swinging movement of the pendulum, but will remain in position to indicate the point of maximum reverse swing as the pendulum returns.

Means are provided for holding the pendulum in its initial raised position and for releasing it to fall therefrom, said means comprising a bifurcated catch or claw 60 at the top of the frame which is adapted to engage with a suitably shaped collar 61 on the pendulum rod 5. The catch arms 60 are mounted on a horizontal shaft 62 journaled in the top of the frame and a lever 63 is attached to the shaft for manually tripping the catch.

The invention further embodies novel means for braking or damping the fall of the pendulum after reaching its maximum height on its reverse swing after breaking the specimen. Said means comprises a friction disc 70 concentric with the pendulum shaft 7 and having rotary frictional contact with the inner surface of the leg 3 of the frame. The disc 70 is preferably made of bronze and is provided with a raised annular machined surface 71 on its inner face near its periphery. Said surface 71 is adapted to engage a correspondingly machined surface 72 on the inner face of the leg 3, the leg being formed with a circular boss 69 concentric with and slightly larger than the disc 70. The disc 70 is mounted to rotate horizontally about the axis of the shaft 7 in the leg 3 and is provided with a horizontally extending hub or journal 73 which projects through a suitable bore in the leg 3. The hub 73 is hollow to accommodate the right hand end of shaft 7 and contains the race for the ball bearing 10 on its inner surface as shown.

Except during the braking operation on the return fall of the pendulum, the disc 70 and its attached parts are adapted to remain stationary and permit free rotation of the shaft 7 within the hub 73. For this purpose the frictional surfaces 71 and 72 are tightly engaged, the disc 70 being forced toward the leg 3 by spring pressure. As embodied, the outer porton 75 of the hub 73 projects from the leg 3 and has mounted about it a helical spring 76, the inner end of which is attached to a collar 77 which lies against the leg 3, while the outer end of the spring is connected to a collar 78 which has screw-threaded attachment to the hub 75. The compression of the spring can be varied by turning the threaded collar 78 on the hub. For convenience of assembly the hub member 75 may be a separate piece from the member 73 and the two are preferably joined by screw-threaded attachment 79 as shown in Fig. 6.

For performing the braking operation, means are provided to temporarily connect the shaft 7 to the disc 70 and thereby cause the frictional engagement between the surfaces 71 and 72 to be exerted to retard the motion of the shaft. As embodied, a rod 80 is pierced by the shaft 7, said rod being mounted within the hollow pendulum rod 5 and having cross-wise pins 81 projecting horizontally at its either end. Said pins are adapted to lie in suitable channels 82 in either side of the casting 8. An annular series of spaced-apart holes 85 are formed in the brake disc 70 opposite the ends of the pins 81 and in normal operation the rod 80 and pins 81 are so positioned that the ends of the pins clear the holes 85 in the disc 70 and thus permit free rotation of the shaft 7.

Means are provided for shifting the rod 80 and the pins 81 along the shaft 7 and thereby causing the pins 81 to enter the holes 85 in disc 70 at the will of the operator. As embodied, the rod 80 is loosely mounted on the shaft 7 but is caused to rotate therewith by a pin 86 which projects through the rod 80 and into the interior of shaft 7 by means of a horizontal slot 87 (Fig. 2) formed in the shaft. As shown in Fig. 6 the shaft 7 is hollowed out from its left hand end to beyond the mounting of rod 80 and a push rod 90 is slidably mounted therewithin. The inner portion of the pin 86 is fixed to the rod 90 and the slot 87 in the shaft 7 serves to limit the axial movement of the push rod 90 and the rod 80 which is carried therewith. The push rod 90 extends beyond the left hand end of shaft 7 and is fitted with a suitable push and pull hande or knob 91 at its protruding end.

The operation of the hereinbefore described braking mechanism is as follows:

During the normal operation of the testing mechanism, the pendulum is released by the catch 60 and falls freely to the nadir of its swing, there contacting and breaking the specimen. The pendulum then swings upwardly on its reverse arc until it reaches its upper limit, the pointer 55 being stationed to indicate that limit as hereinbefore described. Immediately thereafter the operator may push in the knob 91 and the pins 81 will find two of the holes 85 in the disc 70, thereby linking the pendulum shaft 7 to the frictionally retarded disc 70. This operation will effectively brake the falling of the pendulum, the deceleration thereof being adjustable by varying the compression of the spring 76 as previously described. The brake may be released by pulling out the knob when the pendulum has stopped.

The invention further comprises means for making tension impact tests on appropriate specimens therefor and such mechanism is illustrated in Figs. 7 and 8. As shown, suitable spaced-apart anvils 95 and 96 may be mounted on the faces of the legs 2 and 3 in place of the blocks 30 and 31 used for the Charpy tests. These anvils

form a yoke-like projection from the machine and extend horizontally at the level of the center of the anvil hammer or bob 6 when same is at the nadir of its arc. The tension specimen T is seated in the bob preferably by means of a screw-threaded plug 97 for which the bob is suitably recessed at 99. The opposite end of the tension specimen T may be fixed to a cross bar 100 which is adapted to bridge and strike the ends of the anvils in a known manner. It will be clear that the impact on the tension specimen occurs just as the pendulum reaches its nadir and is thus in a horizontal plane.

The invention in its broader aspects is not limited to the specific mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What I claim is:

1. An impact-testing machine including in combination a frame, a specimen-breaking hammer comprising a pendulum rotatably mounted on the frame, means in the path of swing of the pendulum for supporting an Izod specimen anvil, other means also in the path of swing of the pendulum for supporting a Charpy specimen anvil, the bob of said pendulum having passageways for clearing both said supports and anvils, whereby either type of test may be performed without interference from the other support and anvil and said bob having means for removably and interchangeably supporting a centrally disposed knife with a horizontal edge for impacting the vertically disposed Izod specimen and having a centrally disposed knife with a vertical edge for impacting the horizontally disposed Charpy specimen.

2. An impact-testing machine including in combination a frame, a specimen-breaking hammer comprising a pendulum rotatably mounted on the frame, means in the path of swing of the pendulum for supporting an Izod specimen anvil, other means also in the path of swing of the pendulum for supporting a Charpy specimen anvil, the bob of said pendulum having means for removably and interchangeably supporting knives for impacting Izod specimens and for impacting Charpy specimens, said bob having passageways for clearing both said supports and anvils, whereby either type of test may be performed without interference from the other support and anvil.

3. An impact-testing machine including in combination a frame, a specimen-breaking hammer comprising a pendulum rotatably mounted on the frame, means in the path of swing of the pendulum for supporting an Izod specimen anvil, spaced apart supports for Charpy specimen anvils for holding a Charpy specimen across the path of the pendulum, said bob being bifurcated to straddle the Izod support and anvil and being of reduced width and thickness for clearing the Charpy supports and anvils and means for removably attaching a selected knife to said bob.

4. An impact-testing machine including in combination a frame, a pendulum rotatably mounted in said frame, means for supporting impact specimens in the path of swing of the pendulum, and a brake for damping the travel of the pendulum comprising friction means having wear surfaces independent of and acting at the axis of the pendulum and normally disengaged from the pendulum and manually operable means for selectively engaging the brake and the pendulum, whereby wear on the brake does not alter the momentum of the pendulum.

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