

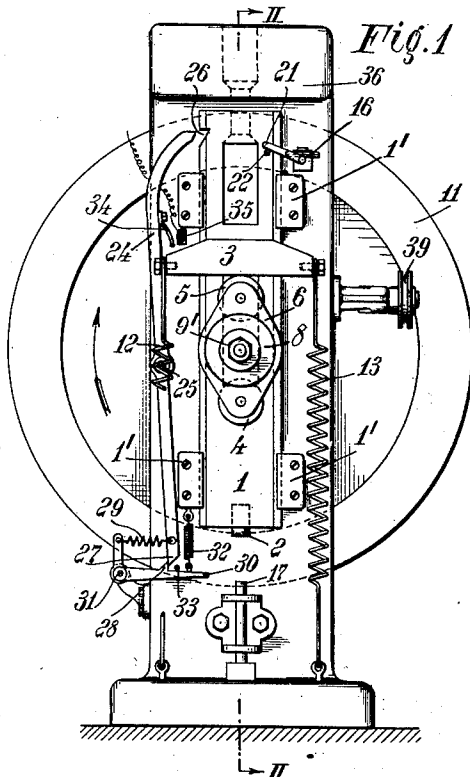
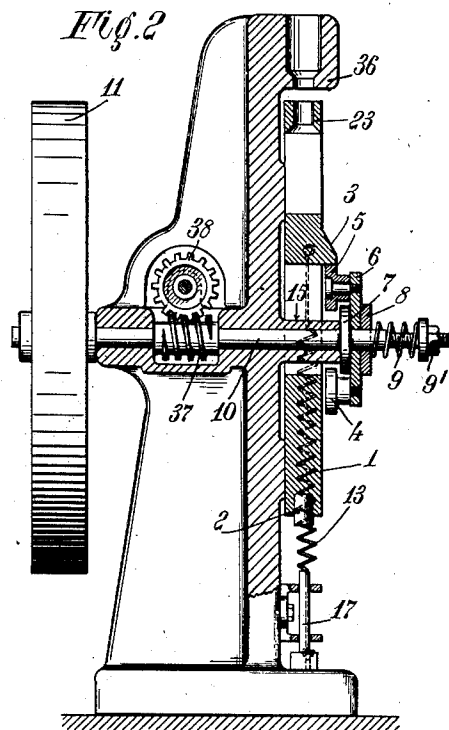
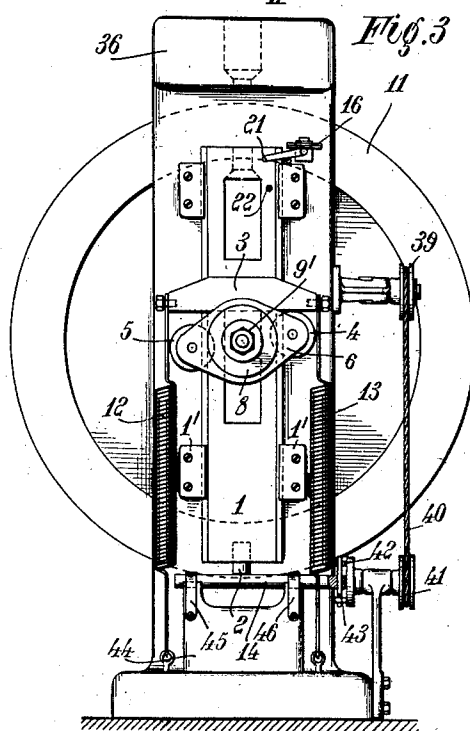
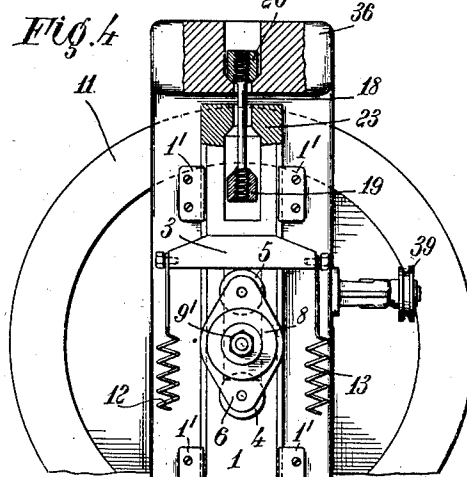
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TESTING MACHINE

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UNITED STATES PATENT OFFICE.

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TESTING MACHINE.

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The present invention relates to improvements in a ram which is particularly adapted for carrying out fatigue tests on test pieces by subjecting the latter to blows of the same impact and following one another as quickly as possible and so often until a fracture of the test piece occurs. The fatigue tests may be carried out with test pieces subjected to bending, compression or tensile stresses.

With known rams for carrying out long-run tests the force of the percussion depends on the weight of the hammer and the velocity at which the testing machine of this type may run is substantially dependent on the speed of fall of the hammer. The velocity of the known rams is therefore limited; and as in most cases several hundred thousands of blows have to be exerted during a long-run impact test, such tests extend sometimes over weeks.

These drawbacks are overcome by the ram according to the present invention.

The ram according to the invention comprises a shaft rotating at a uniform speed and provided with two crank pins arranged diametrically opposite to each other and a hammer moving in guides, the hammer being always maintained in contact with one or the other of the crank pins, by the action of a spring except during the short period immediately after the hammer reaches the test piece, whereby the hammer is moved towards and away from the test piece so that during each cycle the hammer impacts on the test piece with the same kinetic energy which is only dependent on the mass of the hammer and on the eccentricity and rotating speed of the crank pins, the gravity action of the hammer weight and the frictional resistances of the latter being eliminated.

Preferably means are provided in order to keep the test piece in such a spaced relationship to the eccentricity of the crank pins that the test piece is hit by the hammer following up one of the crank pins as the hammer has attained its maximum speed whereupon the rebounding hammer is overtaken by the other crank pin immediately after the impact and is returned into its initial position.

During the downward movement of the hammer the speed of the latter is equal to

the instantaneous vertical speed of the contact point between the crank pin and the part of the hammer contacting with the crank pin and such speed is thus independent of other minor forces, such as friction, or the force of gravity. The force of the spring must be sufficient to maintain the hammer in contact with one of the crank pins which for the time being is moving away from the hammer. The kinetic energy dissipated on the test piece is, therefore, a function of the speed of the shaft of the testing machine and of the vertical distance between the plane of the hammer when in the uppermost position and the point of impact on the test piece. At a given speed of the shaft and a given eccentricity of the crank pins the hammer impacts with the same speed and therefore with the same force on the test piece; the impact force does not depend on the force of the springs, as is the case with known testing machines for this purpose.

A suitable selection of the speed of the shaft, of the eccentricity of the two crank pins and of the force of the spring acting on the hammer enables to obtain any desired kinetic energy of the hammer and any number of blows per unit of time within a wide range.

If the test piece subjected to impact tests were perfectly elastic the hammer would rebound with the same speed with which it hits on the test piece. Owing to the imperfect elasticity of the test piece the hammer always rebounds with a smaller speed. In order to avoid unfavorable shocks occurring at the moment when the crank pin overtakes the rebounding hammer it is advantageous to make the crank pins resilient by fixing the latter to a member which is adapted to carry out a relative displacement with respect to the driving shaft against a frictional resistance, the latter will have to be so adjusted that it is large enough to lift the hammer. The shocks occurring between crank pins and hammer are resiliently taken up and cause only a small angular displacement between the member carrying the crank pins and the shaft.

A constructional example of the ram according to the present invention is illustrated in the accompanying drawings in which:

Fig. 1 is a front elevation of the ram used to subject a test piece to compression stresses,

Fig. 2 is a vertical section along line II—II of Fig. 1.

Fig. 3 is a front elevation with parts broken away of the ram applied to subject a test piece to bending stresses, whereby the hammer is shown in its lowermost position, and

Fig. 4 is part of a front elevation of the ram in its application for subjecting a test piece to tensile stresses.

Referring to the constructional example illustrated in the drawings 1 denotes the hammer adapted to move up and down in the vertical direction in guides, for instance prismatic guides 1'. 2 designates the head or pane of the hammer which hits on the test piece 17 for compression tests (Figs. 1 and 2) or on the test piece 14 for bending tests (Fig. 3). The hammer is provided with a traverse 3 with the lower face of which the two crank pins 4 and 5 formed as rollers cooperate in order to control on the one hand the downward movement of the hammer and, on the other hand, to lift the latter. The crank pins, i. e. the rollers 4 and 5 are mounted on a disc 6 loosely mounted on the driving shaft and the disc 6 is clamped in between the discs 7 and 8 which are pressed against each other by the spring 9 the pressure of which can be adjusted by means of the nut 9'. The friction thus generated between the discs 6, 7 and 8 is the driving connection between the driving shaft 10 and the rollers 4 and 5. The term "crank pins" used in this connection shall be interpreted to include also eccentrics. To the driving shaft 10 on which the flywheel 11 is mounted, rotation at a uniform speed is imparted by a motor not illustrated on the accompanying drawings. 12 and 13 denote helical tension springs connected with their one ends to the traverse 3 and with their other ends to the frame of the apparatus, so that they continuously pull the hammer in the downward direction into contact with one or the other of the crank pins or rollers 4 and 5, so that the hammer follows during the rotation of the crank pins that crank pin which moves away from the hammer. Obviously compression springs acting on the top of the traverse may be used instead of the tension springs 12 and 13.

In Fig. 3 of the drawings the hammer is shown in a position in which the pane 2 just touches the test piece 14 and the roller 4 has just got out of contact with the traverse whilst between the roller 5 and the traverse 3 a small clearance exists which must be of such a size as to permit an appropriate deflection of the test piece. These conditions are obtained by a suitable dimensioning of the means determining the elevation of the

test piece relatively to the eccentricity of the crank pins. The test piece is hit immediately before the hammer has reached its maximum speed, whereupon the rebounding hammer is overtaken by the roller 5 immediately after the impact and is lifted by this roller into its uppermost position illustrated in Figs. 1 and 2, whereupon the cycle is performed anew the roller 4 effecting now the lifting of the hammer previous to the next working stroke.

When a rupture of the test piece occurs or when the latter deflects beyond a predetermined amount the hammer abuts against a stop 15 (Fig. 2) which limits its downward stroke. Thereupon a device is actuated which secures the hammer in its uppermost position and causes the ram to be cut out of action. This device is illustrated in Fig. 1 and comprises a pawl 24 turnable about a pivot 25 and adapted to enter with its upper end into a notch 26 provided on the hammer. The lower end 27 of the pawl is pressed against a tooth 28 by the action of the spring 29. The tooth 28 is provided on a one armed lever 30 pivoted at 31 and held by the action of a spring 32 against a stop pin 33 so that the free end of the lever 30 projects into the path of the hammer when the latter moves beyond the downward stroke determined by the test piece in case of rupture of the latter. In this case the hammer causes a turning of the lever 30 so that the tooth is withdrawn and the pawl 24 released; the latter is then turned towards the hammer and enters the notch 26 of the hammer which has been moved meanwhile into its uppermost position and is thereby held in this position. In order to cut out the motor driving the ram a contact spring 34 is provided on the pawl which co-operates with a stationary contact 35 whereby an electric circuit is closed which operates in a well known manner a cut-out switch for the motor.

A counter 16 provided with an arm 21 against which a pin 22 provided on the hammer strikes registers the number of impacts of the hammer which have been necessary for effecting the destruction of the test piece.

Fig. 4 illustrates the ram in its application for subjecting the test piece to tensile stresses, whereby the uppermost transverse portion 23 of the hammer hits against a sleeve 19 screwed to the lower end of the test piece whilst a similar sleeve 20 screwed to the upper end of the test piece rests in the top portion 36 of the frame.

When a test piece is subjected to bending stresses the test piece has to be turned either continuously or intermittently about its axis so that the blows of the hammer act in a uniform manner on the whole circumference of the test piece. A device for effecting the

turning of the test piece is illustrated in Figs. 2 and 3 of the accompanying drawings. The turning motion is derived from a worm 37 on the driving shaft 10 and is transmitted by the intermediary of a worm wheel 38, an upper grooved pulley 39, a cord 40, a lower grooved pulley 41 and a coupling 42 co-operating with a pin 43 passing transversely through the test piece 14. The latter is held in position on its support 44 by means of the resilient straps 45 and 46.

Obviously the hammer of the ram could be guided in a different direction and it could work even from below against the test piece as the kinetic energy of the hammer is independent of the gravity or it could be guided along a circular path without departing from the spirit of the present invention.

I claim:

1. In a ram particularly adapted for carrying out long-run impact tests on test bars, the combination with a driving shaft rotating at a uniform speed, of members eccentric to said shaft and diametrically opposite each other and rotating about the axis of said shaft, a hammer co-operating with said members, guide means for said hammer and springs in operative connection with said hammer and maintaining the latter substantially constantly in contact with one or the other of said members whereby the hammer is moved towards and away from the test piece and hits the latter with the same force which only depends on the mass of the hammer, on the eccentricity and the speed of rotation of said members, and is independent on the gravity action of the hammer weight and on its frictional resistances and the force of the springs.

2. In a ram particularly adapted for carrying out long-run impact tests on test bars, the combination with a driving shaft rotating at a uniform speed, of members eccentric to said shaft and diametrically opposite each other and rotating about the axis of said shaft, a hammer co-operating with said members, guide means for said hammer, springs in an operative connection with said hammer and maintaining the latter substantially constantly in contact with one or the other of said members, whereby the hammer is moved towards and away from the test piece, and means adapted to hold the test piece in such a position with respect to the eccentricity of said members that the test piece is hit by the hammer following one of said members as the hammer approaches its maximum speed whereupon the rebounding hammer is overtaken by the other of said members and is returned into its initial position.

3. In a ram particularly adapted for carrying out long-run impact tests on test bars, the combination with a driving shaft rotat-

ing at a uniform speed, of members eccentric to said shaft and diametrically opposite each other and rotating about the axis of said shaft, a hammer co-operating with said members provided with a facing with which said members cooperate, vertical guide means for said hammer, springs in operative connection with said hammer and maintaining the latter substantially constantly in contact with one or the other of said members, whereby the hammer is moved towards and away from the test piece, and means adapted to hold the test piece in such a position with respect to the eccentricity of said members that the test piece is hit by the hammer following one of said members as the hammer approaches its maximum speed whereupon the rebounding hammer is overtaken by the other of said members and is returned into its initial position.

4. In a testing machine, a reciprocable hammer, eccentric rotating means for determining the speed of said hammer, means to maintain the hammer in contact with the speed determining means during its operative stroke, means for supporting a test piece to be struck by said hammer as the hammer approaches its maximum speed, whereby the hammer is supported and controlled during movement against the test piece by said eccentric rotating means.

5. In a ram particularly adapted for carrying out long-run impact tests on test bars, the combination with a driving shaft rotating at a uniform speed, of members arranged eccentrically to said shaft and diametrically opposite each other, a frictional driving connection interposed between said members and said shaft to cause said members to rotate about the axis of said shaft, a hammer co-operating with said members, guide means for said hammer and springs in operative connection with said hammer and maintaining the latter substantially constantly in contact with one or the other of said members whereby the hammer is moved towards and away from the test piece and hits the latter with the same force which only depends on the mass of the hammer, on the eccentricity and the speed of rotation of said members, and is independent on the gravity action of the hammer weight and on its frictional resistances.

6. In a ram particularly adapted for carrying out long-run impact tests on test bars, the combination with a driving shaft rotating at a uniform speed, of members arranged eccentrically to said shaft and diametrically opposite each other, an adjustable frictional driving connection interposed between said members and said shaft to cause said members to rotate about the axis of said shaft, a hammer co-operating with said members, guide means for said hammer and springs in operative connection with said hammer

and maintaining the latter substantially constantly in contact with one or the other of said members whereby the hammer is moved towards and away from the test piece and
5 hits the latter with the same force which only depends on the mass of the hammer, on the eccentricity and the speed of the rotation of said members, and is independent on the gravity action of the hammer weight and
10 on its frictional resistances.

7. In a ram particularly adapted for carrying out long-run impact tests on test bars, the combination with a driving shaft rotating at a uniform speed, of members arranged
15 eccentrically to said shaft and diametrically opposite each other, an adjustable frictional driving connection between said members and said shaft to cause said members to rotate about the axis of said shaft, a hammer
20 co-operating with said members, guide means for said hammer, springs in operative connection with said hammer and maintaining the latter substantially constantly in contact with one or the other of said members,
25 whereby the hammer is moved towards and away from the test piece, and means adapted to hold the test piece in such a position with respect to the eccentricity of said members that the test piece is hit by the hammer
30 following one of said members as the hammer reaches its maximum speed whereupon the rebounding hammer is overtaken by the other of said members and is returned into its initial position, and means
35 operated by said hammer and adapted to lock the latter in a fixed position when the operative stroke of the hammer unduly increases beyond a predetermined limit.

8. In a ram particularly adapted for carrying out long-run impact tests on test bars, the combination with a driving shaft rotating at a uniform speed, of members arranged
40 eccentrically to said shaft and diametrically

opposite each other, an adjustable frictional driving connection between said members
45 and said shaft to cause said members to rotate about the axis of said shaft, a hammer co-operating with said members, a head on one end of said hammer co-operating with a test piece when subjecting the latter to
50 upsetting or bending stresses and the other end of said hammer being adapted for co-operating with a test piece when subjecting the latter to tensile stresses, guide means
55 for said hammer springs in operative connection with said hammer and maintaining the latter substantially constantly in contact with one or the other of said members, whereby the hammer is moved towards and
60 away from the test piece, and means adapted to hold the test piece in such a position with respect to the eccentricity of said members that the test piece is hit by the hammer following one of said members as the hammer
65 reaches its maximum speed whereupon the rebounding hammer is overtaken by the other of said members and is returned into its initial position, and means operated by said hammer and adapted to lock the latter in a fixed position when the operative stroke
70 of the hammer unduly increases beyond a predetermined limit.

9. In a ram particularly adapted for carrying out long run tests on test bars, the combination with a driving shaft and members
75 eccentric to and rotated by said shaft; of a hammer, spring-means to urge the hammer into contact with said members, said members releasing said hammer as it approaches its maximum impact speed when
80 it strikes a test piece with a force that is independent of the force of said spring-means.

In testimony whereof I affix my signature.

DR. ALFRED AMSLER.