

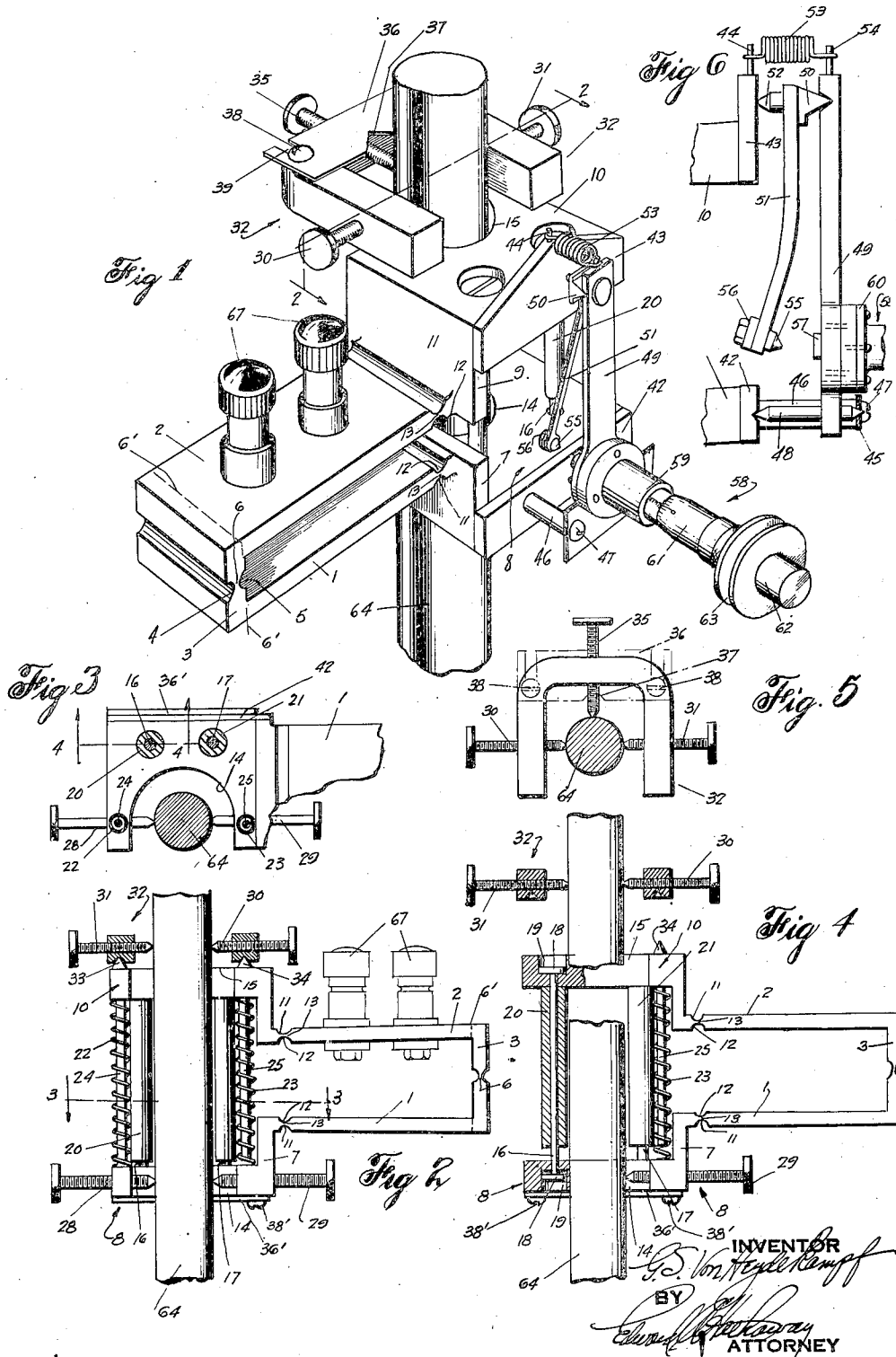
April 20, 1937.

G. S. VON HEYDEKAMPF

2,077,598

EXTENSOMETER

Filed Jan. 14, 1933



UNITED STATES PATENT OFFICE

2,077,598

EXTENSOMETER

Gerd S. von Heydekampf, Chester, Pa., assignor
to Baldwin-Southwark Corporation, a corporation
of Delaware

Application January 14, 1933, Serial No. 651,790

7 Claims. (Cl. 33—147)

This invention relates generally to extensometers and more particularly to an improved extensometer adapted to remain attached to a specimen during failure thereof without injury to the extensometer.

In the use of usual forms of extensometers it is necessary to remove the same from a specimen before its breaking point is reached to prevent injury to the extensometer, this being particularly true of cast iron or other brittle material where failure occurs suddenly. Hence with these arrangements it is impossible to obtain complete stress-strain data right up to the point of failure.

It is one object of my invention to provide an improved extensometer adapted to permit strain readings through the point of failure and particularly to allow the instrument to remain attached to a specimen during failure thereof without injury to the extensometer. A further object is to provide an improved extensometer frame having a plurality of separable or relative movable parts adapted to be held in normal operative fixed relation to each other and to a specimen during normal testing but upon failure of the specimen said plurality of parts will function to avoid injury to the extensometer frame or any of its parts.

Another object is to have an extensometer of the foregoing type, particularly a strain averaging extensometer, provided with improved means whereby the extensometer may be attached to specimens of different diameters or sizes without affecting the accuracy of the readings or the averaging characteristics thereof. In the specific aspect of this phase of the invention I have provided an extensometer having gripping heads axially offset from the body or yieldable portion of the main frame whereby a pair of opposed adjustable gauge contacts are adapted in an improved manner to render the extensometer accurately available for specimens of different diameter. In general, to accomplish the various objects I have provided a normally breakable frame comprising a main frame having a gripping head and a normally separable gripping head engaging a dummy or platform head formed as part of the main frame. A further object is to provide improved means for centering the separable gripping head and also to maintain the head substantially normal to the specimen axis. I also preferably employ yieldable means for holding the separable parts of the extensometer together while it is attached to an unbroken specimen. Another object is to have an extensometer of the type herein disclosed provided with

improved strain averaging means and micrometer adjusted electrical contacts adapted to be connected to any suitable recording mechanism with means for automatically adjusting the contacts during strain of the specimen.

Other objects and advantages will be more apparent from the following description of the accompanying drawing in which:

Fig. 1 is a perspective of my improved extensometer applied to a specimen which is only partially shown;

Fig. 2 is a side elevation of the extensometer taken on a vertical plane substantially on the line 2—2 of Fig. 1;

Fig. 3 is a horizontal section taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a side elevation of the extensometer as it appears after the specimen has failed, parts of the extensometer frame being shown in section along the line 4—4 of Fig. 3;

Fig. 5 is a plan view of the normally separable gripping head.

Figure 6 is a side elevation of the strain averaging means, parts being broken away.

One form which the invention may take, among possible others, is shown herein as comprising a main frame having substantially parallel side legs 1 and 2 connected by an end leg 3 which is relieved as by opposed transverse grooves 4 and 5 to provide an axially extending reduced portion or web 6. It will be noted that these legs are formed of relatively wide flat material of narrow thickness thereby providing a high degree of rigidity in the transverse direction together with sufficient flexibility in the relieved portion of the frame to permit relatively free axial movement during strain of the specimen. The sides 1 and 2 and end 3 may be formed from a single integral member although it is preferable that these component parts be formed separate and then welded, soldered or otherwise suitably secured along abutting surfaces indicated by the dotted lines 6'.

The free end of side 1 has an axially extending portion 7 transversely offset from, or appreciably wider than, the sides 1 and 2 while a gripping head generally indicated at 8 projects laterally from portion 7 and is axially offset from side leg 1, thus providing broadly an offset head in one or both of different directions. The other side leg 2 has an axial portion 9 likewise wider than said side legs to carry an offset dummy head or platform 10. The head 8, portion 7 and side leg 1 are preferably formed from a solid piece of metal suitably machined to the shape shown al-

though if desired these component parts may be formed separately and welded together along butt joints in the manner as shown by the lines 6'. The same integral or separate construction may be employed for head 10, portion 9 and side leg 2. The side legs 1 and 2 are relieved on each of their opposite sides as indicated at 11 and 12 thereby to provide reduced horizontal portions or webs 13. Suitable relatively large recesses 14 and 15 are formed respectively in the heads 8 and 10, those recesses being of any suitable shape and of sufficient size to receive specimens of different diameters or cross sections.

The heads 8 and 10 are prevented from having excessive axial movement away from each other due to the provision of preferably two stop rods 16 and 17 extending through suitable aligned openings in each of said heads and provided with enlarged portions 18 receivable in suitable recesses 19 to engage the bottoms thereof to limit movement of the heads. On the other hand to obtain uniform gauge length of the extensometer whenever applied to a specimen, spacing sleeves 20 and 21 respectively surround rods 16 and 17 so as to abut against the heads when the same are pressed together by the operator's fingers, it being preferable that these sleeves are soldered or otherwise fixed to one of the heads such as 10. There is also provided strain follow-up compression springs 22 and 23 interposed between heads 10 and 8 and surrounding guide rods 24 and 25 which are preferably carried by one of the heads such for example as 10 in spaced relation to the other head. The gauge or spacer sleeves 20 and 21 are preferably disposed to one side of the head as shown in Fig. 3 while the follow-up springs 22 and 23 are disposed preferably in vertical alignment with the gripping points to be described presently.

The gripping head 8 has opposed adjustable threaded gauge points 28 and 29 with the screw 29 disposed beneath the side leg 1 of the main frame. The use of opposed adjustable points is found to be highly desirable and is definitely provided for by having the gripping head 8 offset from the frame side 1. As a result of this improved arrangement, specimens of different diameters may be received centrally within recess 14 with proper engagement and adjustment of each of the gauge points.

If usual extensometer practice was followed, a second set of gauge points would be carried by head 10 but it is seen that if such an arrangement were employed down through failure of the specimen, as when under tension, then the breaking in half of the specimen would cause one set of gauge points to be carried by one of the broken halves of the specimen and the other set of points by the other half, with consequent excessive pull and injury to the frame. To overcome this very serious objection and also to permit stress-strain data to be obtained down to the point of failure, I have provided a second set of points 30 and 31 carried by separable means in the form of a supplemental frame or normally separable gripping head generally indicated at 32, this head being of substantially U-shape with the gauge point in the form of screws 30 and 31 threaded in the sides of the frame. The side legs of the separable frame have suitable recesses of conical or other desired shape to receive conical abutment points 33 and 34 whereby a fixed relation may be effected between the separable gripping head and main frame. A third screw 35 performing what might be termed a leveling func-

tion is adjustably threaded in the end of the separable head 32 to engage the specimen at 90° from the other gauge points and thus prevent downward swinging of the separable frame about the axis of gauge point screws 30 and 31.

To facilitate centering of the separable head with respect to the specimen, there is provided a centering plate 36 having a V-shaped notch or other suitable recess 37 engaging the surface of the specimen. This plate is normally held in any fixed adjusted position by two screws 38 having threaded engagement with separable frame 32 and receivable in slots 39 of the plate. A similar centering plate 36' is adjustably held by screws 38' to the underside of gripping head 8, but engages the specimen on its side opposite to plate 36.

To measure the strain of the specimen there is provided a lower plate 42 and upper plate 43 each of which is welded, soldered or otherwise suitably secured to the edges of heads 8 and 10, it being noted that plate 43 tapers upwardly to carry a pin 44. These plates are preferably formed separately and then attached to said heads to permit a simple machining operation of the gripping heads 8 and 10 although if desired the heads and plates may be formed from a single piece suitably machined to the form shown. A pivot plate 45 is held in spaced relation to plate 42 as by a pair of spacer sleeves 46 and screws 47 extending through plates 43, 45 and sleeves 46 for threaded engagement with lower gripping head 8. An averaging pin 48, journaled in plates 42 and 45, has its axis substantially in the center of the gripping heads so as to normally intersect the axis of a properly centered specimen. A supporting arm 49 is carried by and projects upwardly from pin 48 so as to have engagement at its upper end with a knife edge 50 of a bell crank lever 51 which is preferably bent inwardly at its lower end as shown for purposes of obtaining unrestricted operation of the various elements. Disposed in alignment with the knife edge, which extends in a horizontal direction, is an upper averaging pivot 52 carried by bell crank lever 51 for pivotal engagement with the top plate 43. The axis of this averaging point is substantially in the center of upper head 10 for normal intersection with the axis of a properly centered specimen. The knife edge 50 and pivot 52 are held in their respective bearings by a spring 53 which has one end connected to pin 44 and the other end to a pin 54 projecting from arm 49.

The lower end of lever 51 carries an insulated electrical contact point 55 having a nut 56 to which an electrical wire may be connected for transmitting to any suitable recording mechanism the electrical impulses created by engagement between contact 55 and the adjustable stem or contact 57 of a micrometer generally indicated at 58. This micrometer has a fixed housing 59 provided with a flange 60 suitably rigidly secured to arm 49 and insulated therefrom. The usual micrometer rotatable barrel 61 carrying suitable graduations is adapted upon rotation of the micrometer head 62 to cause rotation and axial adjustment of the micrometer stem or screw contact 57. The micrometer head may be either manually adjusted or if the stress-strain recording mechanism is of the automatic type having suitable rotatable restoring means, this restoring means may be connected by belt or other suitable flexible means to a pulley 63 on head 62.

Operation.—My improved extensometer is ap-

plied to a specimen by first centering the specimen and head 8 with centering plate 36' and then securing the lower gauge points 28 and 29 to a specimen, e. g. 64, whereupon the upper head 10 is pressed downwardly against the compression of springs 22 and 23 until spacer sleeves 20 and 21 engage the lower head, thus determining a fixed gauge length. The normally separable gripping head 32 is then placed around preferably the opposite side of the specimen and seated upon abutment points 33 and 34 with center plate 36 preferably adjusted into contact with the specimen for insuring proper centering. With the upper and lower heads 8 and 10 still compressed and the separable head resting on points 33 and 34, the upper gauge points 30 and 31 are then brought into engagement with the specimen to hold the instrument in its operative relation. To prevent downward swinging movement of the separable head about the gauge points 30 and 31, levelling screw 35 engages the side of the specimen. The specimen is now subjected to an increasing load or stress with the result that elongation of the specimen will permit the upper and lower sets of gauge points 30, 31 and 28, 29 to move axially away from each other although the upper platform of dummy head 10 will have its abutting points 33 and 34 kept in engagement with the separable head 32 by virtue of the strain follow-up springs 22 and 23 urging the head 10 upwardly. As the extensometer expands, bell crank 51 will swing about knife edge 50 in a clockwise direction so as to break engagement between electrical contacts 55 and 57. The micrometer head is then either automatically or manually adjusted to reestablish engagement between said electrical contacts to allow current to flow from the insulated point 55 and 57 to one or the other of binding posts 67 carried by and insulated from the side leg 2, the other binding post being connected by flexible wire to the micrometer screw. When the specimen ultimately fails, the separable head 32 will remain with one part of the broken specimen and the main extensometer frame will remain with the other part of the specimen, the separable head merely separating from points 33 and 34 without any injury, shock or distortion of any kind to the main frame. The maximum separation of the heads 8 and 10 at the instant of failure is limited by rods 16 and their heads 18. In the event that the opposite sides of the specimen to which the opposed gauge points are attached should have unequal elongation such as might occur due to unequal loading still there is obtained the average elongation of the specimen or the elongation at the axis thereof. This average strain is accomplished due to the averaging pins 48 and 52 intersecting the specimen axis, although during any unequal elongation the upper and lower heads will assume a slightly inclined position which is permitted due to the relieved portions 13 while further flexibility of the two heads is permitted by the relieved portion 6. To insure that the abutment points 33 and 34 will both remain in complete contact with the separable head during any inclination of the upper and lower gripping heads, the strain follow-up springs 22 and 23 are disposed preferably in alignment with each of the abutment points 33 and 34.

From the foregoing disclosure it is seen that I have provided an extremely simple and yet highly effective means for permitting an extensometer to remain attached to a specimen during breaking thereof and thus allowing complete stress-strain

data to be obtained right up to the point of failure. It is also seen that I have provided in an instrument of this kind an extremely rugged construction and yet one which has all the sensitivity and refinements required in a scientific instrument of this character together with simple and effective means for obtaining the average strain together with other features hereinbefore set forth or which are inherent in the structure disclosed including, for instance, the adaptability of the instrument for compression or tension loading or for loading and unloading under either tension or compression tests thereby to obtain hysteresis data.

It will of course be understood that those skilled in the art may obtain the various results and advantages of my invention by making various changes in the elements and rearrangements thereof without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. An extensometer comprising a main frame, means associated with said frame normally in fixed relation thereto but separable therefrom upon failure of the specimen, yieldable strain follow-up means for normally maintaining said frame and separable means into contact with each other when the extensometer is attached to a specimen, normally inactive means operative upon failure of a specimen to limit movement of said frame, and strain responsive means operatively associated with said frame.

2. An extensometer comprising a main frame formed of inflexible relatively flat thin material with relieved flexible portions, the thin edges of said frame lying in planes substantially parallel to the axis of a specimen to be tested, a gripping head carried by said frame and offset therefrom both axially and transversely of the specimen, gauge points carried by said head for attaching said frame to a specimen, a dummy head also carried by said frame, a substantially U-shaped separable gripping head, abutment points through which said separable head is normally supported on said dummy head in spaced relation thereto, and gauge points carried by said separable head for engaging a specimen.

3. An extensometer comprising a main frame formed of inflexible relatively flat thin material with relieved flexible portions, the thin edges of said frame lying in planes substantially parallel to the axis of a specimen to be tested, a gripping head carried by said frame and offset therefrom both axially and transversely of the specimen, gauge points carried by said head for attaching said frame to a specimen, a dummy head also carried by said frame, a substantially U-shaped separable gripping head normally disposed in supporting contact with said dummy head, and gauge points each adjustably carried by said separable head for engaging a specimen.

4. An extensometer comprising an integral U-shape flexible frame, a gripping head formed on one end of the frame for direct attachment to a specimen, a dummy head formed on the other end of the frame, a second gripping head for direct attachment to a specimen and adapted during such attachment to have a normally fixed contact with said dummy head but being adapted to separate therefrom upon failure of the specimen, and strain indicating mechanism associated with the two ends of the integral U-frame.

5. An extensometer comprising an integral U-shape flexible frame, a gripping head formed on one end of the frame for direct attachment to a

specimen, a dummy head formed on the other end of the frame, a second gripping head for direct attachment to a specimen and adapted during such attachment to have a normally fixed contact with said dummy head but being adapted to separate therefrom upon failure of the specimen, means between the dummy head and second gripping head to maintain the same in normally fixed lateral relation, and strain indicating mechanism associated with the two ends of the integral U-frame.

6. An extensometer comprising an integral U-shape flexible frame, a gripping head formed on one end of the frame for direct attachment to a specimen, a dummy head formed on the other end of the frame, a second gripping head for direct attachment to a specimen and adapted during such attachment to have a normally fixed contact with said dummy head but being adapted to separate therefrom upon failure of the specimen, and strain indicating mechanism associated with the two

ends of the integral U-frame, including a leverage system having members normally permanently pivotally connected to the two ends of the integral frame.

7. An extensometer comprising an integral U-shape flexible frame, a gripping head formed on one end of the frame for direct attachment to a specimen, a dummy head formed on the other end of the frame, a second gripping head for direct attachment to a specimen and adapted during such attachment to have a normally fixed contact with said dummy head but being adapted to separate therefrom upon failure of the specimen, springs for urging said first gripping head and said dummy head away from each other thereby to maintain said normally fixed contact with the second gripping head, and strain indicating mechanism associated with the two ends of the integral U-frame.

GERD S. VON HEYDEKAMPF.