May 16, 1933. R. L. TEMPLIN 1,908,930

EXTENSOMETER

Filed June 16, 1930 2 Sheets-Sheet 1

Fig. 4.

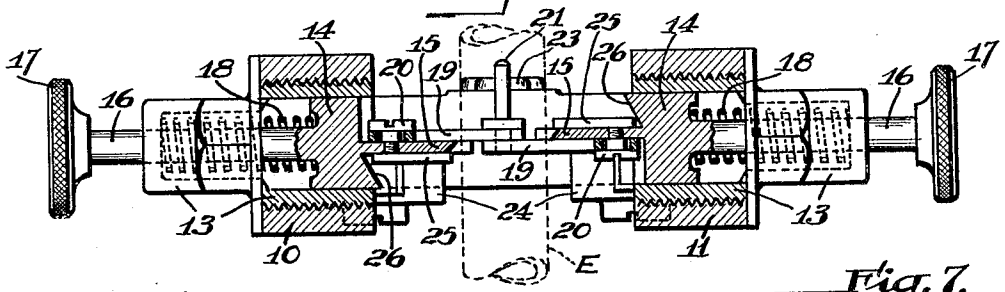


Fig. 6.

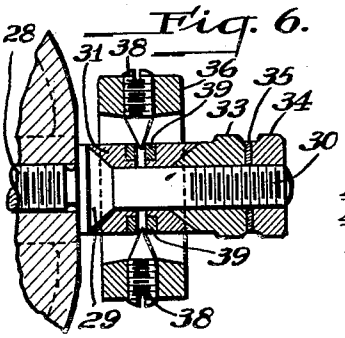
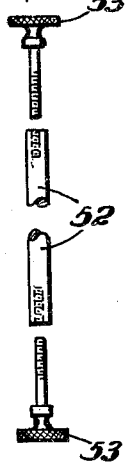


Fig. 7.



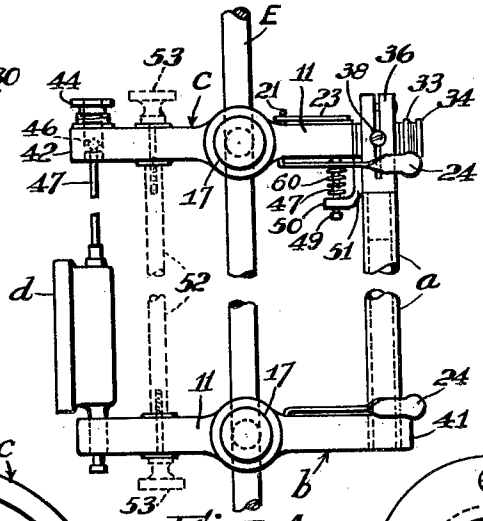
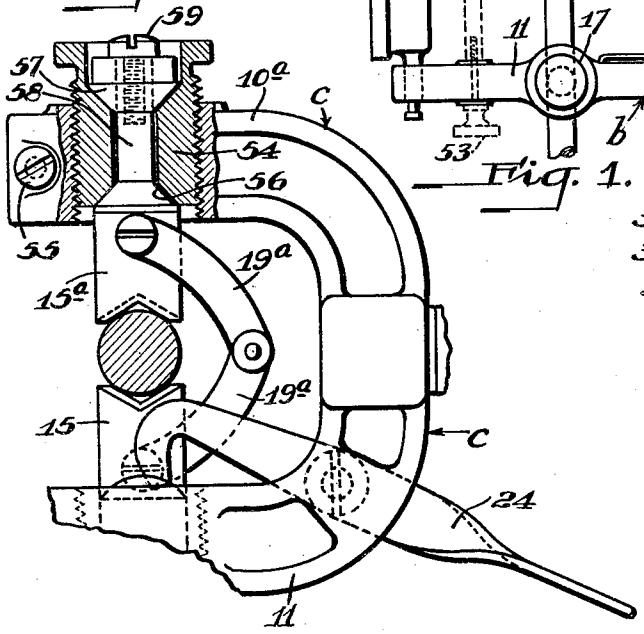


Fig. 1.

Fig. 8.



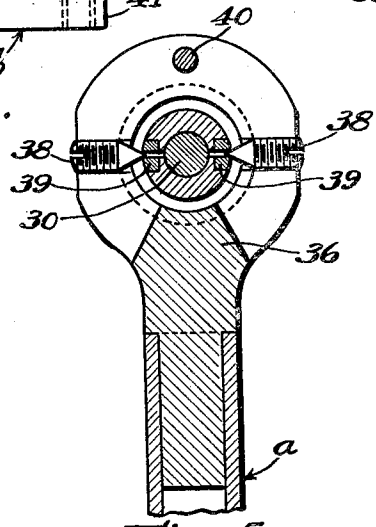


Fig. 5.

WITNESSES

A. B. Wallace.

E. O. Johns

INVENTOR

Richard L. Templin

By Brown & Critchlow

Attorneys.

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EXTENSOMETER

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Fig. 3

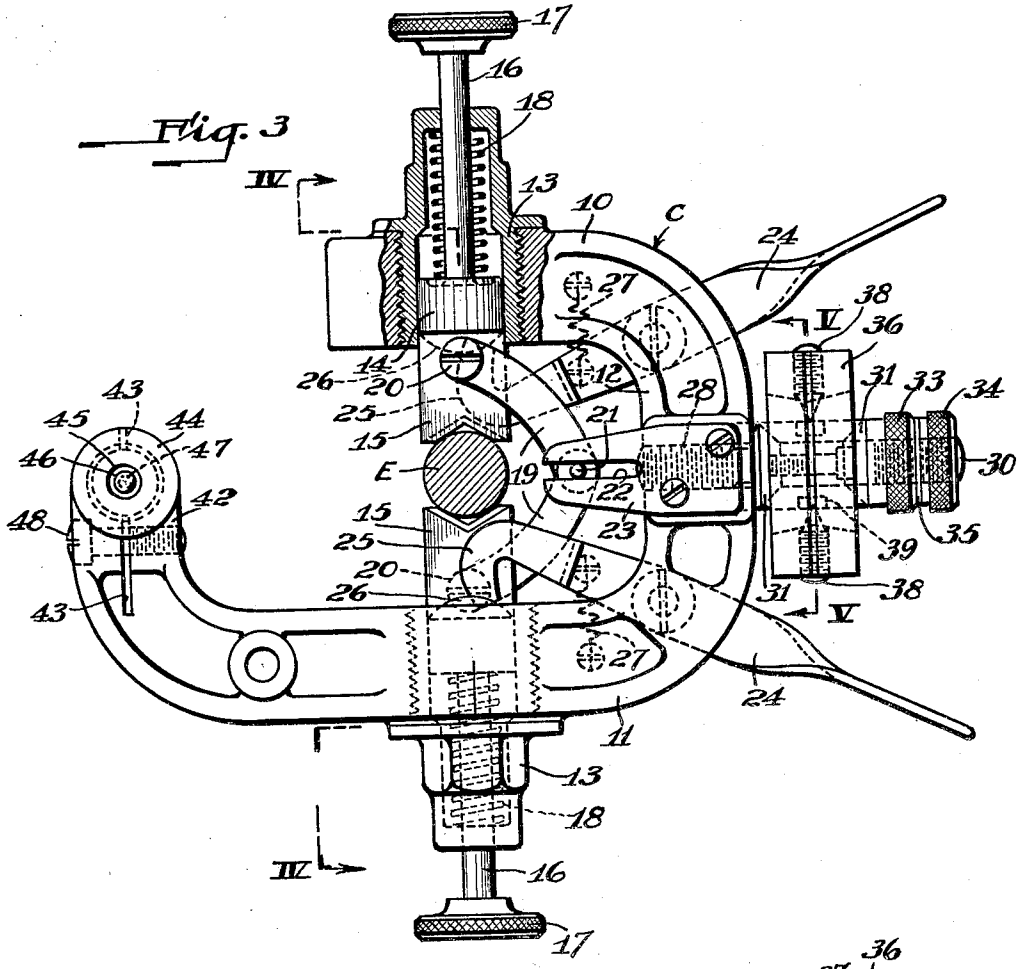
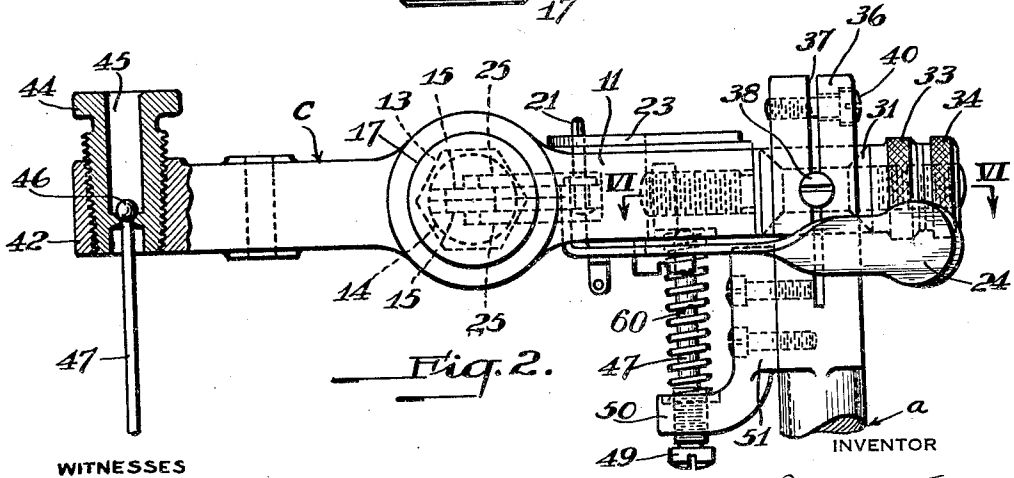


Fig. 2.



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E. O. Johns

INVENTOR

Richard L. Templin

By Brown & Critchlow

Attorneys.

Patented May 16, 1933

1,908,930

UNITED STATES PATENT OFFICE

RICHARD L. TEMPLIN, OF PARNASSUS, PENNSYLVANIA, ASSIGNOR TO ALUMINUM COMPANY OF AMERICA, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

EXTENSOMETER

Application filed June 16, 1930. Serial No. 461,382.

My invention pertains to the instruments known as extensometers which are used for measuring the elongation of specimens under the tension applied by a testing machine or the like. One object is to improve upon extensometers, as heretofore produced, in regard to precision. Another object is to provide an extensometer which can be attached to and removed from the specimen, when the latter is in place in the machine, with exceptional facility. And other objects of my invention and advantages secured thereby will appear from the following specification taken in connection with the claims annexed thereto.

I have described by way of example in the following specification and shown in the accompanying drawings one form of extensometer in which my invention may be embodied, together with a modified form which one of the elements of the device may take. I wish it understood, however, that my invention may be embodied in other forms, and that changes may be made in the forms described and shown, without exceeding the scope thereof as defined by the appended claims.

In the drawings:

Fig. 1 is a side view of the extensometer, shown as applied to a specimen under test;

Fig. 2 is a side elevation, partly in section, of the upper yoke which forms part of the instrument;

Fig. 3 is a plan, partly in section, of the parts shown in Fig. 2;

Fig. 4 is a section taken on the line IV—IV of Fig. 3, looking in the direction of the arrows;

Fig. 5 is a section on the line V—V of Fig. 3;

Fig. 6 is a section on the line VI—VI of Fig. 2;

Fig. 7 is a view of the spacing bar detached from the instrument; and

Fig. 8 is a fragmentary view of a similar nature to Fig. 3, but showing a modified means of mounting and operating the specimen-clamping means.

Referring to Fig. 1, the extensometer includes a post a to the bottom end of which is rigidly secured a lower yoke b and to the top end of which is pivoted an upper yoke c. Between the ends of the yokes b and c remote from the post a, is connected an indicator d. Each of the yokes is provided, intermediate its ends, with jaws adapted to seize the specimen E between them. Thus the elongation, under the tension applied by the testing machine, of that portion of the specimen which is enclosed between the jaws of the two yokes, will be shown by the indicator d.

Except in regard to the manner of their support upon the post a and the connections they carry for the indicator d, the yokes b and c are substantially the same. Referring to the upper yoke c, it includes a pair of parallel arms 10 and 11 (Figs. 2–4) joined by a neck 12 at which is located the means for mounting the yoke upon the post a. The arms 10 and 11 are threaded to receive hollow cylindrical bearing members 13 which are disposed opposite to each other and in which are slidably and rotatably mounted plungers 14. The plungers 14 are formed at their inner ends with specimen-engaging and gripping means which, as shown, take the shape of flat jaws 15 having V-shaped knife edges for engaging and gripping the specimen, though other forms of jaws, such as the well known form employing sharp points, might also be used. The knife edges of the jaws are so disposed as to engage the specimen at diametrically opposite points, as may be clearly seen from Fig. 4. The outer ends of the plungers 14 are provided with stems 16 which extend through the bearing members 13 and terminate in knurled heads 17. Springs 18 are disposed between the plungers 14 and the ends of the bearing members 13 and tend to press the plungers strongly towards each other so that their jaws 15 will grip the specimen E firmly.

One of the features of the extensometer is the maintenance of its centering about the axis of the specimen being tested, whereby the instrument is always substantially balanced about such axis and the leverage at which the indicator d is operated always remains the same. To this end, as well as to maintain the knife edges thereof diametrically opposite each other, the jaws 15 are con-

nected by means of a pair of curved links 19 which are pivoted together at one end, their other ends being pivoted to the jaws 15 by means of the studs 20. The pin 21 by means of which the links 19 are pivoted together is extended upward and enters a slot 22 formed in a plate 23 which is secured to the neck 12 of the yoke. It will be observed from this that the links 19, by reason of the guiding of their pivot pin 21 in the slot 22, cause the jaws 15 to move together, and towards and away from the axis of the specimen to the same extent, thereby maintaining a centering of the instrument about such axis at all times. In addition, the links maintain the knife edges of the jaws 15 parallel at all times, regardless of the fact that the plungers 14 carrying such jaws can rotate in the bearing members 13, since it will be observed that the rotation of one of the plungers 14 will be directly imparted to its oppositely disposed plunger by reason of the links 19. This insures the maintenance of the knife edges of the jaws 15 in alignment at all times.

To separate the jaws 15, for applying the instrument to a specimen or removing the instrument, a pair of finger levers 24 are pivoted to the yoke, one at each side of the latter. The inner ends of these finger levers are formed with flat hooks 25 which engage beneath beveled lips 26 formed at the ends of the plungers 14, the hooks being retained in engagement beneath the lips by relatively weak tension springs 27. The construction is such that although the hooks 25, by their engagement beneath the lips 26, will normally hold the jaws 15 in the horizontal position proper for engaging such jaws with the specimen, nevertheless such holding is impositive and the jaws can rotate about their axes when they are definitely impelled to do so, as would be the case when one side of the specimen should stretch to a greater extent than the opposite side. Swiveling of the jaws about their axes under such conditions as the last-named is desirable, as in that way the reading given by the indicator *d* is the mean stretch of the specimen. By compressing the finger levers 24 towards each other the jaws 15 are separated for applying the instrument to the specimen. The finger levers are then released, allowing the springs 18 to force the jaws, which will be maintained horizontal at that time because of the engagement of the finger lever hooks 25 beneath the lips 26, against the specimen, the knife edges of the jaws engaging the specimen at diametrically opposed points.

The swiveling of the jaws 15 would, of itself, only allow for irregularity of stretching of the specimen along two sides. In order to make complete provision for such irregularity of stretching, and to obtain a reading of the true mean stretch, I construct the upper yoke so that it can swivel about an axis at right angles to the axes of the jaws. To this end, the neck 12 of the yoke has threaded thereinto a stud 28 formed with a conical bearing portion 29 and a shank 30 the outer end of which is threaded. The shank 30 is rotatably mounted in a bushing 31 formed at each end with conical bearing surfaces (Figs. 2, 3 and 6), one for engagement by the bearing portion 29 of the stud 28 and the other for engagement by a conical bearing portion formed upon a nut 33 which is threaded upon the shank 30, such nut, after adjustment for a proper rotative connection between the bushing 31 and the stud 28, being secured by means of a lock nut 34 and lock washer 35. It will thus be seen that the upper yoke itself can swivel about the axis of the stud 28 while the jaws can swivel about their own axes disposed at right angles to the axis of such stud, the result being that the jaws are capable of universal movement. In this manner it is assured that the mean stretch of the specimen will be shown by the indicator regardless of along what lines of the specimen any irregularity of stretching occurs.

To connect the upper yoke pivotally with the post *a* the latter is provided with an annular head 36 which is split longitudinally, as indicated at 37. Pointed pivot screws 38 are threaded into the head 36 on the center line of the split and engage hardened pivot bearings 39 secured opposite each other in the bushing 31. A screw 40 passes through one part and enters the other part of the head 36 so that the split portions thereof can be drawn together to clamp the pivot screws 38 after adjustment of the latter. The upper yoke *c* pivots about the screws 38 during the stretching of the specimen. The lower yoke *b* is formed with a collar 41 (Fig. 1) which surrounds the lower end of the post *a* and is shrunk or otherwise rigidly secured thereon.

Referring again to the upper yoke, its arm 11 is extended and bent around to provide a boss 42 which is disposed on a line passing through the axis that will be occupied by the specimen and extending at right angles to the pivotal axis of the yoke. The boss is split, as indicated at 43, and is threaded to receive a thimble 44 formed with a bore 45 having at the lower end thereof a spherical seat to receive a ball 46 formed at the top end of a rod 47 which is connected to the indicator *d* at the upper part thereof. The thimble 44 is adjusted, and then clamped in such adjusted position by means of a screw 48 passing through one part and entering the other of the split boss 42. The adjustment is such that the center of the ball 46, when seated, will be in the same plane with the pivotal axis of the yoke and the specimen-engaging edges of the jaws 15. The lower yoke *b* is provided with means for

connecting the indicator *d* to it directly beneath the thimble 45 carried by the upper yoke, a suitable adjustment being provided, to allow of the proper pull being exercised by the rod 47. The indicator is provided with suitable means for setting it to zero, and may be calibrated as desired, usually in inches of stretch per inch of the specimen.

When the specimen is under test the weight of the upper yoke will operate against the tension being applied by the testing machine, and although the parts of the instrument are made of aluminum where suitable, this would introduce an inaccuracy. To meet this condition I provide a helical spring 60 (Fig. 2) which surrounds an abutment screw 49, the latter being threaded into a horizontal lug 50 projecting from a bracket 51 secured to the head 36 on the post *a*. The spring is disposed between the lug 50 and the lower face of the upper yoke *c*, and is of such calculated strength as to balance the weight of such yoke. In this way any inaccuracy of reading on the indicator *d*, due to the weight of the upper yoke, is obviated.

The indicator is usually calibrated for use upon a determined length of the specimen being tested. Supposing, for instance, that this length is ten inches, the instrument can be placed upon a standard rod having marks thereon which are precisely ten inches apart and the edges of the jaws of the upper and lower yokes be made to strike these marks with precision. Thereupon the screw 49 can be adjusted until it just engages the lower face of the upper yoke and locks in such adjustment. Thereafter the jaw edges of the upper and lower yokes will always be precisely ten inches apart when the upper yoke is resting upon the screw 49.

As another means of setting the instrument to the standard distance, and also as a means for holding the parts securely in place when the instrument is not in use, I provide a spacing bar 52 (Figs. 1 and 7) adapted to engage between the upper and lower yokes and to be secured in place by screws 53 passing through said yokes and entering said spacing bar. The bar may be of such length that when engaged between the yokes, the knife edges of the jaws carried by such yokes will be spaced the required distance apart.

It will be noted that each yoke is broadly in the shape of a rectangle having one corner open, thereby permitting the instrument to be placed on the specimen while the latter is in place in the testing machine, all that is necessary being to manipulate the finger levers so as to separate both pairs of jaws and then allow the jaws to close upon the specimen while the upper yoke is resting upon the screw 49. It will be seen, further, that the construction of the instrument is balanced in that the jaws 25 and associated parts, as well as the portions of the yokes carrying them, are balanced against each other across the axis of the specimen. Likewise the indicator *d* and associated parts are balanced against the post *a*, finger levers 24, etc., across the axis of the specimen. The weight of the parts are calculated to obtain this balance as nearly as possible thereby to avoid any material tendency of the instrument to cant upon the specimen, which canting, if permitted, would tend to introduce inaccuracy.

In the instrument shown the leverage at which the indicator operates is two to one,—i. e. the distance between the center of the ball 46 on the rod 47 connected with the indicator and the pivotal axis of the upper yoke is twice that between such pivotal axis and the axis of the specimen. The leverage may, of course, be designed as desired, but, whatever it may be, such leverage is preserved by the centering character of the jaws, requiring that the axis of the specimen be located always at the same point.

In the construction heretofore described the specimen-engaging jaws are automatically self-centering. In Fig. 8 there is shown a form of the instrument in which the centering of the jaws is obtained by an adjustment instead of automatically. In this form, one of the jaws, designated 15*a*, is rotatably mounted in a sleeve 54 which is threaded into the arm 10*a* of the yoke, such arm being split and provided with a screw 55 for drawing its parts together to secure the sleeve 54 in position after adjustment. The sleeve is formed with conical bearing faces at each end, one for engagement by a conical bearing portion 56 formed on the jaw and the other for engagement by a conical nut 57 threaded upon a shank 58 which extends from the jaw beyond the conical portion 56. A screw 59 locks the nut 57 in position when the latter has been adjusted for a proper rotative connection between the sleeve 54 and the shank 58 and its associated parts. The jaw 15 opposite to the jaw 15*a* is constructed and mounted similarly to the jaws of the construction shown in Fig. 3 and is operated by a finger lever 24 as in such figure. The jaws 15 and 15*a* are connected by links 19*a* which are similar to the links 19 except that the pivot pin connecting the links is not extended and the slotted plate 23 is omitted. The links 19*a*, in this embodiment of the invention, serve only to maintain the jaws 15 and 15*a* in line with each other.

In the use of the instrument, when constructed in accordance with Fig. 8, the sleeve 54 is adjusted so that when the jaw 15*a* engages the specimen, the axis of the latter will be centrally disposed with respect to the instrument. The centering of specimens differing in diameter is thus obtained by an adjustment, instead of automatically as in the embodiment first described. The instrument

is, however, quite convenient to use where the specimens do not frequently vary in diameter. It is applied to the specimen equally as easily as in the form previously described, the single finger levers 24 on both yokes being, of course, operated.

The extensometer of my invention presents the advantage of increased precision in many respects. Especially important is the balanced construction, by which the weight of the parts of the instrument is distributed substantially equally around the axis of the specimen being tested, there being no material tendency of the instrument to cant. Accuracy of the reading obtained is further promoted by the centered construction which insures that the axis of the specimen is always at the same location, thereby maintaining constant the leverage at which the instrument operates, and by the counter-balancing of the weight of the pivoted yoke. In addition to the advantages of extreme accuracy which results from these features and from the capability which the specimen-engaging jaws have of universal movement and the insurance that these jaws engage the specimen at diametrically opposed points, the instrument has the material further advantage that it is exceptionally easy to attach to the specimen when the latter is in the testing machine, especially, where the specimens vary in diameter, in the case of the automatically centering form shown in Figs. 2—4. Moreover, the instrument is easy to set to a predetermined test length of specimen, is rugged and not liable to get out of order, and is of a simple and economical construction.

I claim:

1. An extensometer comprising a pair of spaced yoke members pivotally mounted to have universal movement with respect to each other, indicating means connected between said yoke members at their other ends, and self-centering specimen-engaging means carried by said yoke members intermediate their ends, whereby the extensometer is balanced about the specimen.

2. An extensometer comprising a support, a member movably associated with said support, a second member associated with said support, indicating means connected between said members, and self-centering specimen-engaging means carried by each of said members and disposed intermediate said support and said indicating means, whereby the extensometer is balanced about the specimen.

3. An extensometer comprising a support, a member pivoted adjacent one end to said support, a second member fixed adjacent one end to said support, indicating means connected between said members adjacent the ends thereof remote from said support, and self-centering specimen-engaging means carried by each of said members intermediate their ends, whereby the extensometer is balanced about the specimen.

4. An extensometer comprising a yoke, oppositely disposed self-centering jaw members individually rotatable in said yoke, and means for maintaining said jaw members in alignment with each other.

5. An extensometer comprising a support, a jaw-carrying yoke rigidly attached to said support, a member pivoted to said support, a second yoke rotatably mounted in said pivoted member, and self-centering jaw members individually rotatable in said second-named yoke.

6. An extensometer comprising a support, a jaw-carrying yoke rigidly attached to said support, a member pivoted to said support, a second yoke rotatably mounted in said pivoted member, jaw members individually rotatable in said second-named yoke, and means for maintaining said jaw members in alignment with each other.

7. An extensometer comprising a yoke, oppositely disposed jaw members individually rotatable in said yoke, and links pivoted to each other and to said jaw members to maintain the latter in alignment.

8. An extensometer comprising a support, a jaw-carrying yoke rigidly attached to said support, a member pivoted to said support, a second yoke rotatably mounted in said pivoted member, oppositely disposed jaw members individually rotatable in said second-named yoke, and links pivoted to each other and to said jaw members to maintain the latter in alignment.

9. An extensometer comprising a yoke, a jaw member carried by said yoke, a second jaw member disposed opposite the first and movably mounted in said yoke, means tending to move said second-named jaw member towards said first-named jaw member to clamp a specimen between them, and manually operable means for moving said second-named jaw member away from said first-named jaw member.

10. An extensometer comprising a yoke, a jaw member mounted for rotation in said yoke, a second jaw member disposed opposite the first and mounted for rotation and longitudinal movement in said yoke, means tending to move said second-named jaw member towards said first-named jaw member to clamp a specimen between them, and manually operable means for moving said second-named jaw member away from said first-named jaw member.

11. An extensometer comprising a yoke, a jaw member mounted for rotation in said yoke, a second jaw member disposed opposite the first and mounted for rotation and longitudinal movement in said yoke, means tending to move said second-named jaw member towards said first-named jaw member to clamp a specimen between them, manu-

ally operable means for moving said second-named jaw member away from said first-named jaw member, and means for maintaining said jaw members in alignment with each other.

12. An extensometer comprising a yoke, a jaw member mounted for rotation in said yoke, a second jaw member disposed opposite the first and mounted for rotation and longitudinal movement in said yoke, means tending to move said second-named jaw member towards said first-named jaw member to clamp a specimen between them, manually operable means for moving said second-named jaw member away from said first-named jaw member, and links pivoted to each other and to said jaw members to maintain the latter in alignment.

13. An extensometer comprising a yoke, a jaw member carried by said yoke, a second jaw member disposed opposite the first and movably mounted in said yoke, means tending to move said second-named jaw member towards said first-named jaw member to clamp a specimen between them, and a manually operable lever pivoted to said yoke and engaging said second-named jaw member to actuate said jaw member and release said specimen.

14. An extensometer comprising a yoke, a pair of oppositely disposed jaw members individually rotatable in said yoke, and means for impositively maintaining said members in a predetermined position of rotation.

15. An extensometer comprising a yoke, a pair of oppositely disposed jaw members individually rotatable in said yoke, means for maintaining said jaw members in alignment with each other, and means for impositively maintaining said members in a predetermined position of rotation.

16. An extensometer comprising a yoke, a jaw member mounted for rotation in said yoke, a second jaw member disposed opposite the first and mounted for rotation and longitudinal movement in said yoke, means tending to move said second-named jaw member towards said first-named jaw member to clamp a specimen between them, and manually operable means for moving said second-named jaw member away from said first-named jaw member, said last-named means comprising a lever having a flattened portion adapted to engage a beveled portion of said last-named jaw member to maintain said jaw member impositively in a predetermined position of rotation.

17. An extensometer comprising a yoke, a jaw member carried by said yoke, a second jaw member disposed opposite the first and movably mounted in said yoke, said second-named jaw member being provided with a bevelled lip, means tending to move said second-named jaw member towards said first-named jaw member to clamp a specimen between them, and a manually operable lever pivoted to said yoke and engaging beneath said lip, for actuating said second-named jaw member and normally maintaining it impositively in a predetermined position or rotation.

18. An extensometer comprising a yoke, a jaw member carried by said yoke, a second jaw member disposed opposite the first and movably mounted in said yoke, said second-named jaw member being provided with a bevelled lip, means tending to move said second-named towards said first-named jaw member to clamp a specimen between them, links pivoted to each other and to said jaw members for maintaining the latter in alignment, and a manually operable lever pivoted to said yoke and engaging beneath said lip for actuating said second-named jaw member and normally maintaining it impositively in a predetermined position of rotation.

19. An extensometer comprising a yoke, a pair of jaw members mounted in said yoke for movement with respect to each other, and means for equalizing the movement of said jaw members.

20. An extensometer comprising a yoke, a pair of jaw members mounted in said yoke for movement with respect to each other, links pivoted to each other and to said jaw members, and a guiding member on said yoke associated with said links at the pivotal connection of the latter, thereby to equalize the movements of said jaw members.

21. An extensometer comprising a yoke, a pair of jaw members mounted in said yoke for rotation and movement with respect to each other, means for maintaining said jaw members in alignment, and means for equalizing the movements of said jaw members.

22. An extensometer comprising a yoke, a pair of jaw members mounted in said yoke for rotation and movement with respect to each other, links pivoted to each other and to said jaw members, and a guiding member on said yoke associated with said links at the pivotal connection of the latter, whereby said links maintain said jaw members in alignment and equalize their movements.

23. An extensometer comprising a yoke, a pair of jaw members mounted in said yoke for movement with respect to each other, means tending to move said jaw members towards each other to clamp a specimen, manually operable means for separating said jaw members, and means for equalizing the movements of said jaw members.

24. An extensometer comprising a yoke, a pair of jaw members mounted in said yoke for movement with respect to each other, means tending to move said jaw members towards each other to clamp a specimen, a pair of manually operable levers pivoted to said yoke and engaging said jaw members, and

means for equalizing the movements of said jaw members.

25. An extensometer comprising a yoke, a pair of jaw members mounted in said yoke for rotation and movement with respect to each other, each of said jaw members being provided with a bevelled lip, springs impelling said jaw members towards each other to clamp a specimen, and a pair of manually operable levers pivoted to said yoke, and engaging beneath said lips, for actuating said jaw members against said springs and maintaining said jaw members in a predetermined position of rotation.

26. An extensometer comprising a yoke, a pair of jaw members mounted in said yoke for rotation and movement with respect to each other, each of said jaw members being provided with a bevelled lip, springs impelling said jaw members towards each other to clamp a specimen, a pair of manually operable levers pivoted to said yoke, and engaging beneath said lips, for actuating said jaw members against said springs and maintaining said jaw members in a predetermined position of rotation, and means for equalizing the movements of said jaw members.

27. An extensometer comprising a yoke, a pair of jaw members mounted in said yoke for rotation and movement with respect to each other, each of said jaw members being provided with the bevelled lip, springs impelling said jaw members towards each other to clamp a specimen, a pair of manually operable levers pivoted to said yoke, and engaging beneath said lips, for actuating said jaw members against said springs and maintaining said jaw members in a predetermined position of rotation, links pivoted to each other and to said jaw members, and a member adapted to guide the common pivot point of said links in a direction perpendicular to the movement of said jaw members whereby the movement of each of said jaw members is equal.

28. An extensometer comprising a pair of yoke members for engaging a specimen at separated points, a support member having one of said yoke members rigidly attached thereto and having a second yoke member pivotally attached thereto, an indicator connected with one of said members, and a ball and socket connection between said indicator and the other yoke member.

29. An extensometer comprising a pair of yoke members for engaging a specimen at separated points, a support member having one of said yoke members rigidly attached thereto and having the second yoke member pivotally attached thereto, an indicator connected with one of said yoke members, a socket adjustably associated with the other yoke member, and a link connected at one end with said indicator and provided at the other end with a ball for cooperation with said socket.

30. An extensometer comprising a yoke member for engaging a specimen, a second yoke member for engaging the specimen above the first, a supporting member having said first mentioned yoke member rigidly attached thereto and having the second yoke member pivotally attached thereto, an indicator connected between said yoke members, an adjustable abutment carried by one of said yoke members and engaging the other, thereby to determine the distance of separation of said yoke members, and a spring interposed between the second named yoke member and the support therefor to balance its weight.

In testimony whereof, I sign my name.

RICHARD L. TEMPLIN.

CERTIFICATE OF CORRECTION.

Patent No. 1,908,930. May 16, 1933.

RICHARD L. TEMPLIN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5. line 71, claim 17, for "or" read "of"; and line 91, claim 19, for "movement" read "movements"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of June, A. D. 1933.

M. J. Moore.

(Seal) Acting Commissioner of Patents.