June 22, 1965 J. P. DE NICOLA ETAL 3,190,007

EXTENSOMETER

Filed Nov. 8, 1962

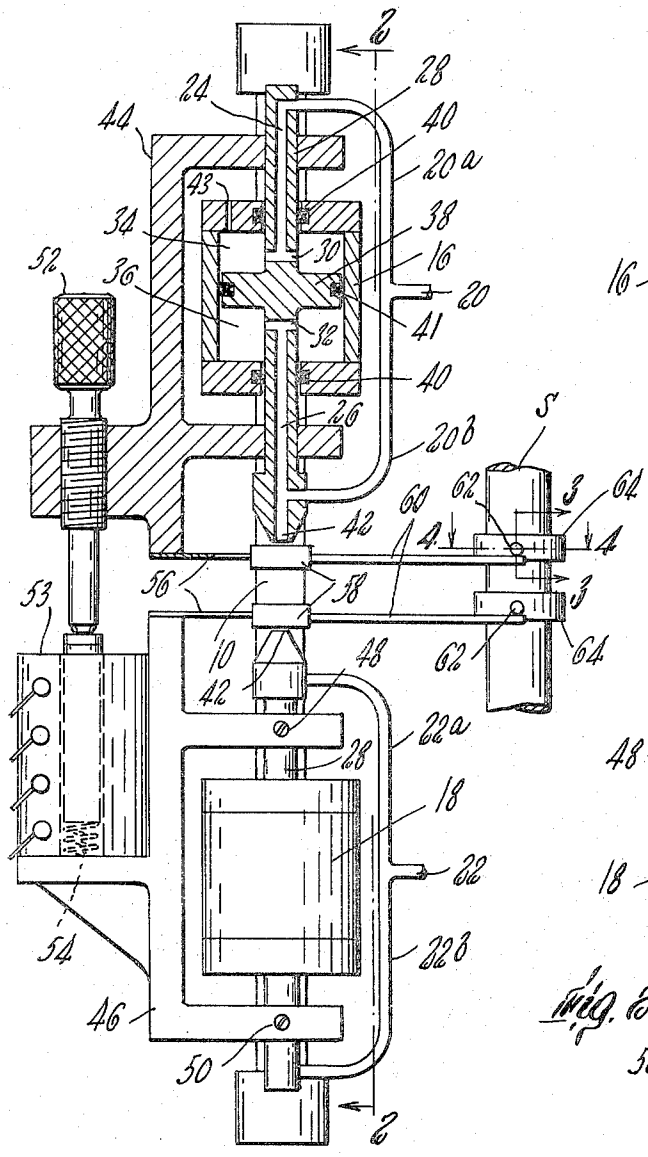

Fig. 1.

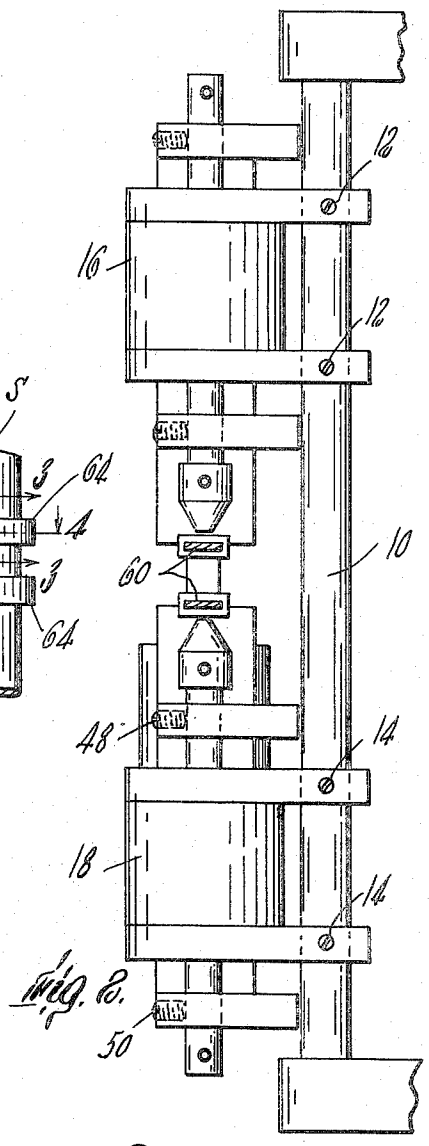

Fig. 2.

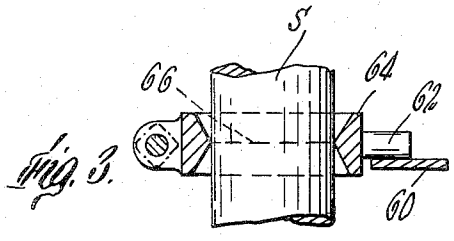

Fig. 3.

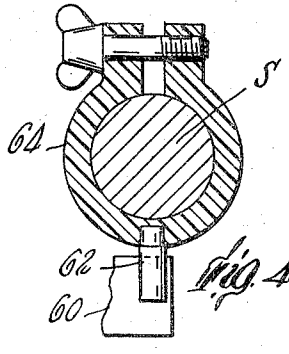

Fig. 4.

United States Patent Office 3,190,007 Patented June 22, 1965

3,190,007

EXTENSOMETER

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Filed Nov. 8, 1962, Ser. No. 236,225
5 Claims. (Cl. 33—147)

This invention relates to extensometers, and more particularly to gas servo extensometers.

It is a primary object of the invention to provide for accurate measurement of extension of a specimen even though the same is characterized by very high degrees of strain responsivity to stress. It is a further object to provide such an extensometer in which any weight that need be carried by the specimen owing to the extensometer is minimized to avoid as much as possible introduction of this extraneous complicating factor. It is yet another object to facilitate production of a signal pursuant to specimen extension which may be easily given any desired magnification, or if desired one degree of magnification during one stage of strain and any other degree of magnification desired during any other stage of strain.

Broadly, the extensometer of the invention features fixing a pair of reference locations at axially spaced locations on a specimen, providing location-responsive valve actuating means, and providing in association therewith gas servo means tracking the valve actuating means, the gas servo means bearing signal producing means.

Other objects, advantages, and features will appear from the following description of a preferred embodiment, taken in conjunction with the attached drawings thereof, in which:

FIG. 1 is a front elevational view, partially in section, of said preferred embodiment;

FIG. 2 is a side elevational view thereof;

FIG. 3 is a sectional view taken at 3—3 of FIG. 1; and

FIG. 4 is a sectional view taken at 4—4 of FIG. 1.

Referring now more particularly to the drawings, there is shown a support 10 upon which are fixed selectively at desired vertical locations by means of set screws 12 and 14 servo gas pressure housings 16 and 18. Gas, suitably air, under pressure is supplied to each servo through tubing 20, 20*a*, and 20*b*; and 22, 22*a*, and 22*b*, respectively. The upper and lower servos have the same construction and mode of operation, so that only the upper is shown and described in detail. The said gas under pressure enters axial passages 24 and 26 of vertically and axially movable slide 28, and thence through horizontal passages 30 and 32 to zones 34 and 36 on opposite sides of piston 38 moving in the cylindrical inner portion of housing 16, the piston 38 being axially movable with the slide 28. Quad rings 40 and 41 provide sealing between piston 38 and slide 28, and housing 16. Nozzle 42 is supplied with gas pressure from tube 20*b* and is in communication with passage 26. Vent 43 communicates with zone 34.

Slide 28 is selectively fixed relative to mounting plates 44 and 46 by means of set screws 48 and 50. Mounted on upper plate 44 is a position setting screw 52, while mounted on the lower plates is an LVDT 53 (or linear variable differential transformer), for example of the type disclosed in United States Patent No. 2,427,866, which is upwardly biased by spring 54.

Fixed on plates 44 and 46 are flat spring steel reeds 56 carrying valve members 58 from which protrude feelers 60 extending underneath pins 62 of light plastic collars 64 clamped around specimen S to define a line location around circular knife edge 66 and act as specimen-attached elements.

In operation, the specimen S is held above and below by a pair of grips (not shown), and in this embodiment the lower grip is moved downwardly relative to the upper.

This has the effect of downwardly moving both clamp rings 64, in differing amounts reflective of extension between the locations defined by the two circular lines 66. As each clamp ring moves downwardly it carries with it its respective feeler 60. As each feeler 60 moves down, it bends reed 56 to lower valve member 58, increasing the gap between the same and nozzle 42. This has the effect of lowering pressure in the zone 36, causing pressure in zone 34 to drive down piston 38 until the gap between valve member 58 and nozzle 42 is once more that which produces equilibrium between pressures in zones 34 and 36. In this manner mounting plates 44 and 46, which are fixed to slides 28, move downwardly the same distances respectively as do the upper and lower lines 66. The amount of extension, or difference between the amount of movement of the two lines 66, is reflected in LVDT 53, which produces an appropriate electrical signal.

Although in the embodiment shown no magnification either positive or negative of the extension in the specimen is carried to the signal-producing means, it will be apparent that the invention makes possible through simple linkages making movement in the signal-producing means less than or more than extension; and if desired, as for specimens which stretch slowly at first and then rapidly, producing a shift in the degree of magnification at a predetermined point. It will also be apparent that another advantage of the invention is that it permits easy adjustment to adapt for maximum use range with different gauge length between the lines 66 by virtue of set screws 12, and screw 52.

Other embodiments of the invention within the following claims will occur to those skilled in the art.

We claim:

1. An extensometer comprising a support, a pair of gas servos carried by said support, each of said servos including a mounting portion and a nozzle, separate means responsive to movement of separate locations on a specimen to produce a tendency to vary the size of a gas gap from each of the respective nozzles, said servos being adapted to maintain a constant gap whereby the respective mounting portions are moved to correspond with movement of said separate locations, and signalling means carried by said mounting portions for signalling relative movement therebetween.

2. The extensometer of claim 1 in which said signalling means is a linear variable differential transformer.

3. An extensometer comprising a first gas servo with a first mounting portion and a first nozzle, a second gas servo with a second mounting portion and a second nozzle, each said mounting portion being operatively secured to the respective said nozzle for movement therewith in an extension direction, a first valve member movable relative to said first nozzle in an extension direction and adapted to be moved in said direction responsive to movement of a location of a specimen in said direction, a second valve member movable relative to said second nozzle in an extension direction and adapted to be moved in said direction responsive to movement of a second location of said specimen in said direction, and a signal producer cooperatively carried by said mounting portions for signalling the distance therebetween.

4. An extensometer for measuring relative change in position of two spaced points on a specimen as defined by first and second reference members coupled directly to said specimen at said two spaced points, said extensometer comprising a motion sensor adapted to be coupled to each said reference member, each said motion sensor including structure defining an orifice, a valve member positioned in front of and spaced from said orifice for controlling the flow of gas through said orifice, means for connecting said valve member to the associated reference member for causing said valve member to move relative to said

orifice in response to the motion of said associated reference member, conduit means for supplying gas for flow through said orifice, and means responsive to a change in gas flow through said orifice produced by a change in the position of said valve member relative to said orifice to reposition said orifice defining structure to maintain a constant gap between said orifice and said valve member, and signaling means coupled between said two orifice defining structures for signaling relative movement therebetween.

5. An extensometer for measuring relative change in position of two spaced points on a specimen as defined by first and second reference members coupled directly to said specimen at said two spaced points, said extensometer comprising a motion sensor adapted to be coupled to each said reference member, each said motion sensor including a nozzle, a nozzle mounting portion, a valve member positioned in front of and spaced from said nozzle for controlling the flow of gas through said nozzle, means for supporting said valve member on said nozzle mounting portion, means for connecting said valve member to the associated reference member for causing said valve member to move relative to said nozzle in response to the

motion of said associated reference member, conduit means for supplying gas for flow through said nozzle, and means responsive to a change in gas flow through said nozzle produced by a change in the position of said valve member relative to said nozzle to reposition said nozzle to maintain a constant gap between said nozzle and said valve member, ouptut means coupled between said mounting portions for sensing the change in position of said mounting portions and producing output signals indicative of such position change, and means to adjust the position of one mounting portion relative to the other mounting portion.

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