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(71) Applicants
Clement Clarke International Limited, Airmed House, Edinburgh Way, Harlow, Essex, CM20 2ED
(72) Inventor
Henry James Stockwell
(74) Agents
Stevens, Hewlett & Perkins, 5, Quality Court, Chancery Lane, London, WC2

(54) Applanation tonometer

(57) An applanation tonometer having an applanating member mounted on an arm pivoted in a body; a manual adjustment knob mounted in the body, and two spiral springs G, H in series between the knob and the arm via an intermediate spindle D, thus giving a low-rate spring arrangement without the attendant difficulty of the spring coils binding on each other.

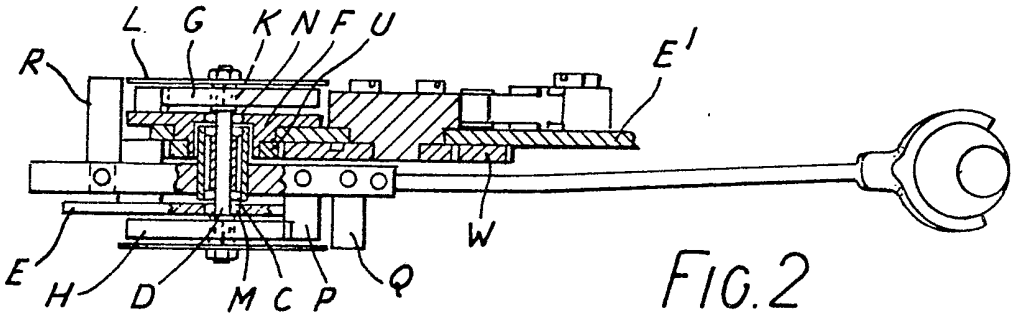

FIG. 2

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

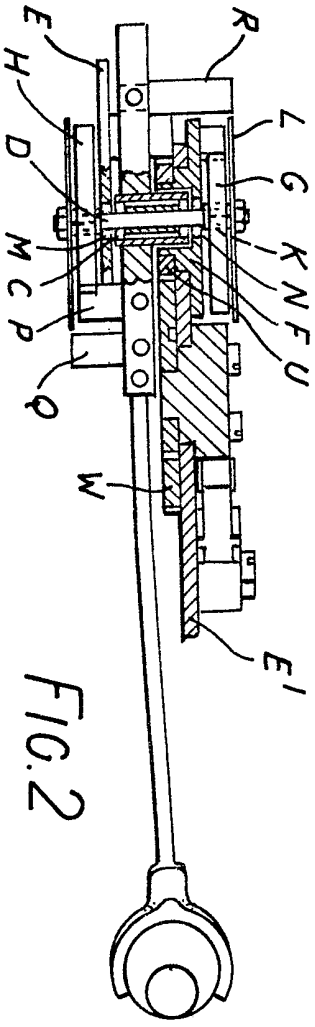


FIG.2

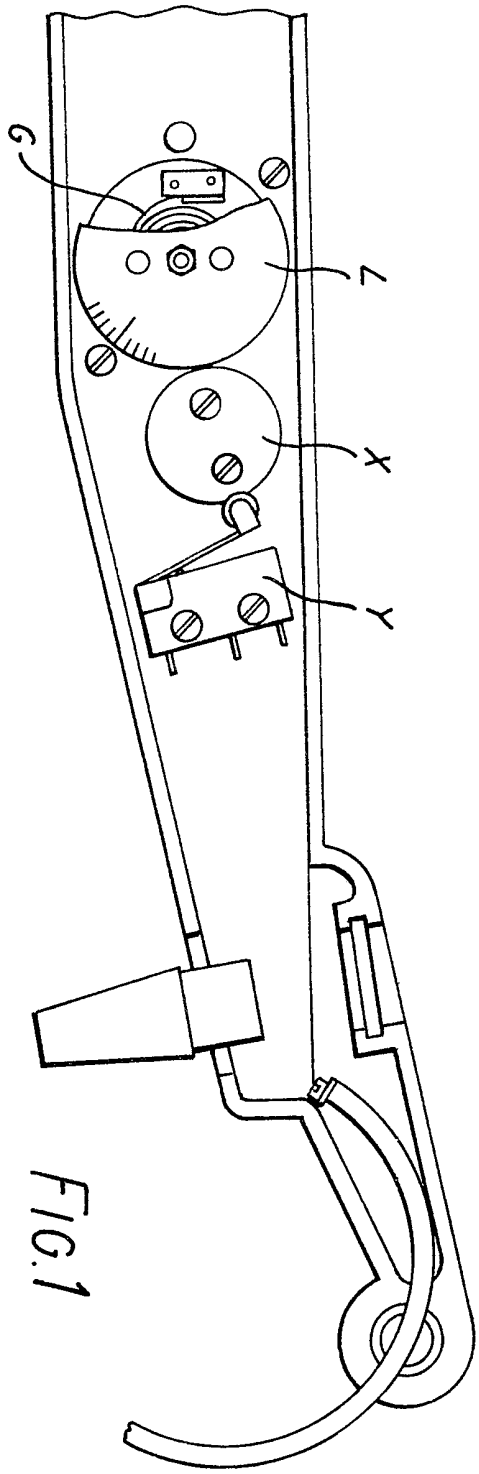


FIG.1

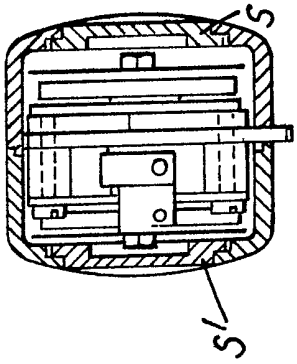
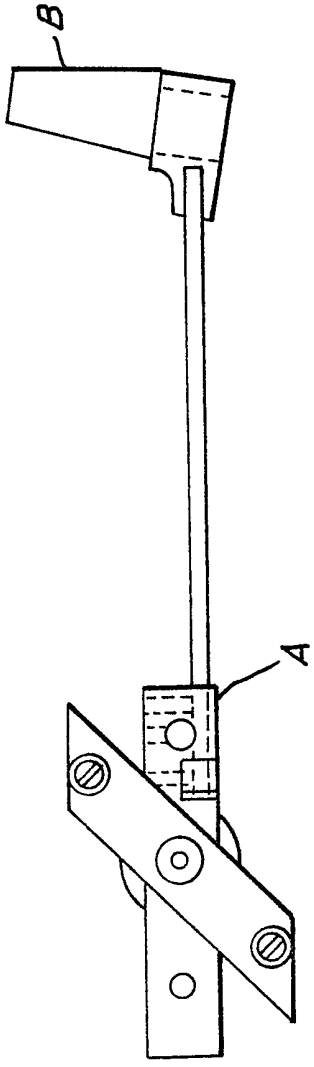
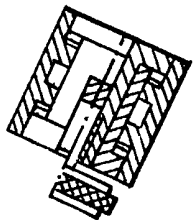


FIG. 3





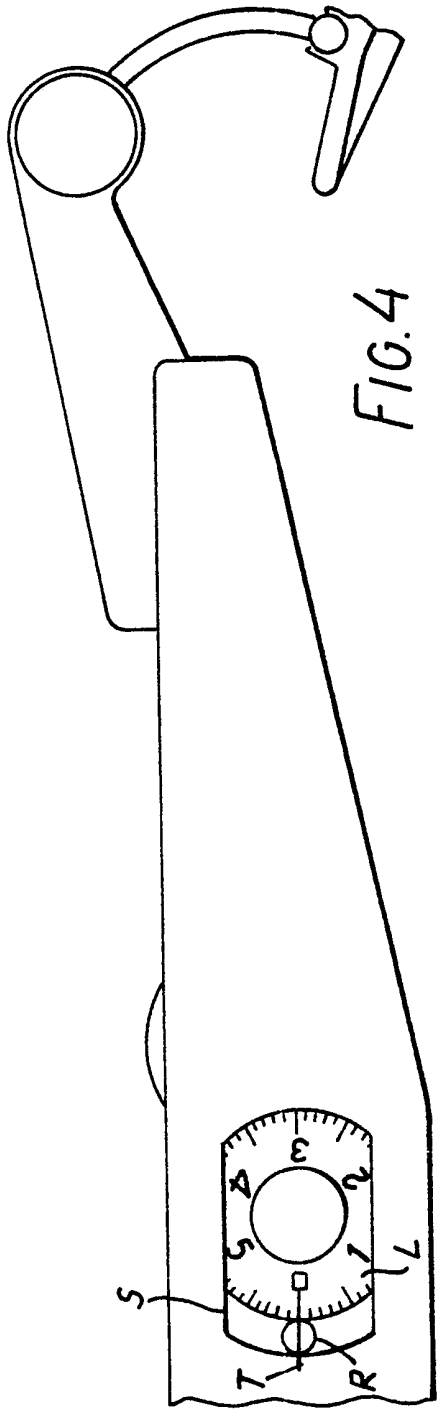


FIG. 4

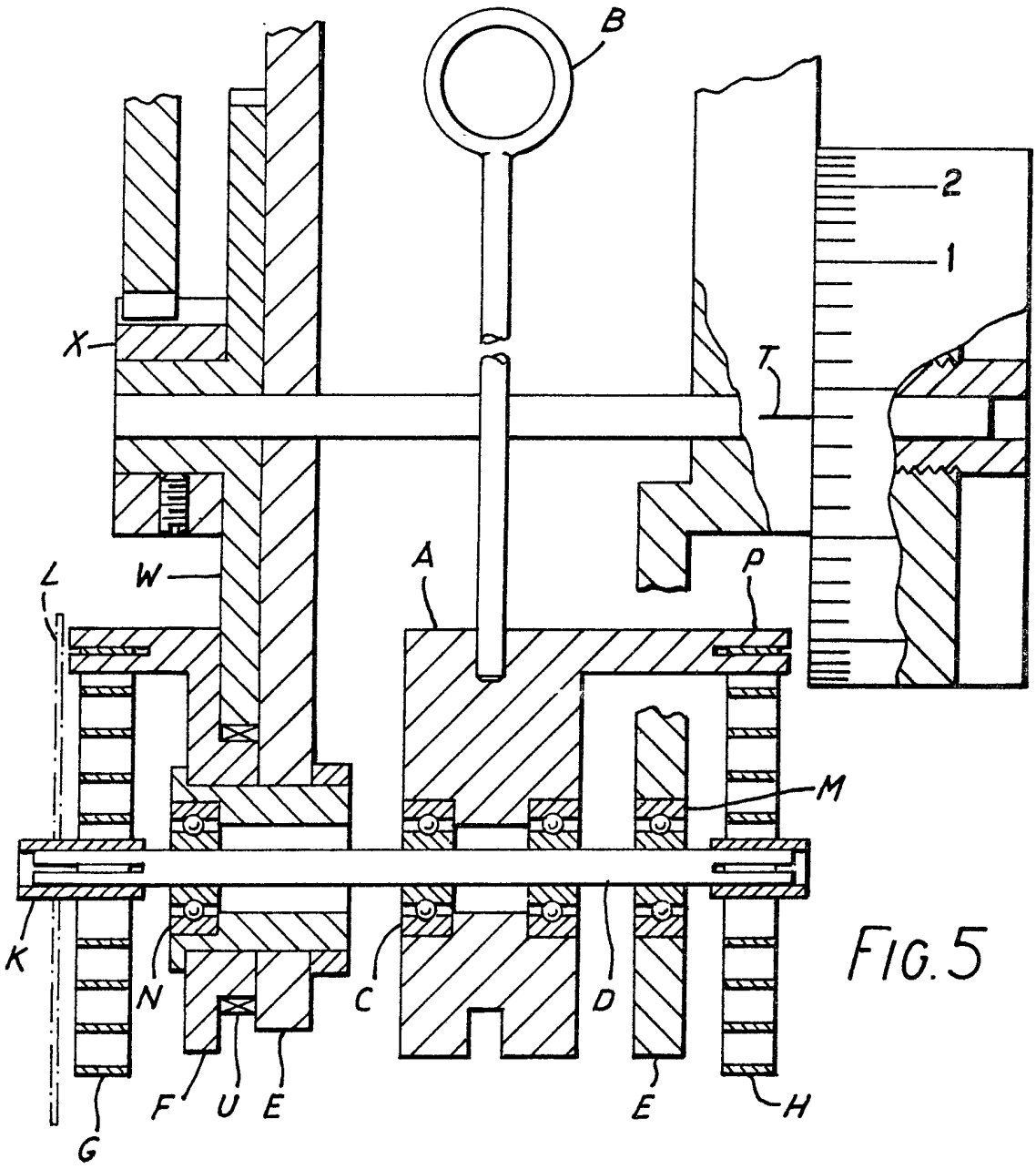


FIG. 5

SPECIFICATION

Improvements in applanation tonometers

In certain eye diseases, notably glaucoma, it is desirable to measure the intraocular pressure; instruments for doing this are called tonometers. The art is well known, and instruments based on several different principles have been proposed.

The present invention is an improvement on a previous design type, namely applanation tonometers, whose features are set out in British Patent No.1360603 which refers to British Patent No.862920.

In Specification No.1360603 there is described an arrangement in which an applanating member is carried on an arm which is coupled to a manual adjustment knob via a spiral spring. The knob is calibrated to derive the spring tension when the applanating member applies the required pressure to the eye.

The main disadvantage of this design is that the scale reading is correct in only one rotary position of the pivot member, due to the fact that rotary displacement of the applanating member either winds up or unwinds the spring. Therefore, there may be a small error in estimating the force actually used at the moment when the pressure is determined, due to the position of the applanation member at that time, compared with its position when calibrated.

An object of the present invention is to reduce that error.

According to the invention there is provided an applanating tonometer having a body; an applanating member mounted on an arm; a spindle pivoted in the body, the arm being rotatably mounted on the spindle; two spiral springs; and a manual adjustment knob rotatable with respect to the body, the first spring being coupled at one end to the knob and at the other end to the spindle and the second spiral spring being coupled at one end to the spindle and at the other end to the arm. This arrangement provides that the springs are in series between the knob and the arm, so providing a low-rate spring arrangement without the attendant difficulty of the spring coils binding on each other.

The knob may be calibrated to give the tonometer reading. However, in a preferred embodiment of the invention a graduated scale is provided on the spindle so that the position of the arm can be read with respect to the spindle. Furthermore, a fiduciary mark is made on the body to allow the arm to be aligned therewith to a calibrating position. This arrangement allows accurate measurement of the spring tension at the arm calibrating position and provides compensation for errors induced by reading the spring tension where the arm is not properly positioned.

The invention will further be described with reference to the accompanying drawings, of which:—

Figure 1 is a side elevation of the mechanism of an applanation tonometer according to the invention;

Figure 2 is a cross-sectional plan view of the mechanism of Figure 1;

Figure 3 is an elevation of the mechanism from the other side;

Figure 4 is an elevation of the tonometer from the first side; and

Figure 5 is a cross-sectional view of another embodiment of the invention.

Referring to the drawing, an arm A carrying an applanating member B is rotatably mounted on low friction bearings C about a rotatably mounted spindle D which is itself mounted in low friction bearings, one of which, M, is supported on a frame E in the body of the tonometer and the other, N, in an anchor wheel F.

The spindle D has a slot at each end to accommodate springs G and H. The anchor wheel is rotatably mounted in the frame E and carries an anchor for the outer end of the spring G, whose inner end is secured to the spindle D by an end cap K and scale disc L. The inside end of spring H is fixed to the other end of spindle D by a similar end cap and scale disc. The outer end of spring H is anchored to a protrusion P on arm A. That arm carries two further protrusions Q and R, each bearing an indicating line which registers against a scale disc. Suppose the springs are identical but are series mounted:

If now the applanating member be restrained by an external source applied at the applanating surface, preventing it from circular motion about the spindle, and the anchor wheel be rotated through an angle θ, the spindle will rotate through an angle $\theta/2$, carrying with it the scale discs, whose scales will register the force applied to the arm carrying the indicator lines. One or two windows S,S^1 in the casing of the tonometer allow the scales to be viewed.

At some convenient position, for example at one third of the travel of the arm from its forward urged position, the scale may be calibrated exactly and a fiducial line engraved on the casing at T indicate that position of calibration. However, if the restraining force be removed from the applanating member, which then rotates through an angle $d\theta$, it will cause the indicator lines to move through the same angle $d\theta$, whilst the discs will move in the same sense through $d\theta/2$. the angular ratio appropriate to the scales on the discs, and the indicators will always measure the force in the springs within their relative linearity limits.

If the rates of the two springs are not quite equal, then the rotation of the spindle will be as a function of their rates. The advantages of the arrangement are that it permits a lower rate of spring to be used without binding coil on coil due to radial or tangential forces, and that adjustment is simply achieved. Furthermore, because the spindle is mounted in bearings in the rotating parts, it tends to rotate in the same direction as the force applied, thus minimizing the effect of friction.

The anchor wheel derives its rotation from a coaxially mounted pinion U which co-operates with a gear wheel W actuated by the thumb of the operator. A co-operating rotary cam X serves to operate a microswitch Y controlling the illumination for the applanating body. The construction allows for illumination of the applanated area by an illuminated ring or a plurality of illuminants directed towards the region of observation.

In an alternative arrangement, illustrated in Figure 5, the scale discs may be omitted and a scale or scales may be mounted coaxially with the thumb wheel W and the indicating line be carried on the body or case of the tonometer. In that arrangement, the advantage of permanent indication veracity is lost, but the advantage of reduced change in force throughout the travel of the applanating body is retained. The position of disc L for the embodiment of Figures 1 to 4 is illustrated in Figure 5 in broken line.

CLAIMS

1. An applanating tonometer have a body; an applanating member mounted on an arm; a spindle pivoted in the body, the arm being rotatably mounted on the spindle; two spiral springs; and a manual adjustment knob rotatable with respect to the body, the first spring being coupled at one end to the knob and at the other end to the spindle and the second spiral spring being coupled at one end to the spindle and at the other end to the arm.

2. An applanating tonometer as claimed in claim 1 wherein a graduated scale is provided on the spindle so that the position of the arm can be read with respect to the spindle and a fiduciary mark is made on the body to allow the arm to be aligned therewith to a calibrating position.

3. An applanating tonometer as claimed in claim 1 wherein the knob is calibrated to give the tonometer reading.

4. An applanation tonometer substantially as hereinbefore described with reference to the accompanying drawings.

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