(No Model.) 3 Sheets—Sheet 1.

B. I. PRICE.

OPHTHALMIC INSTRUMENT.

No. 534,375. Patented Feb. 19, 1895.

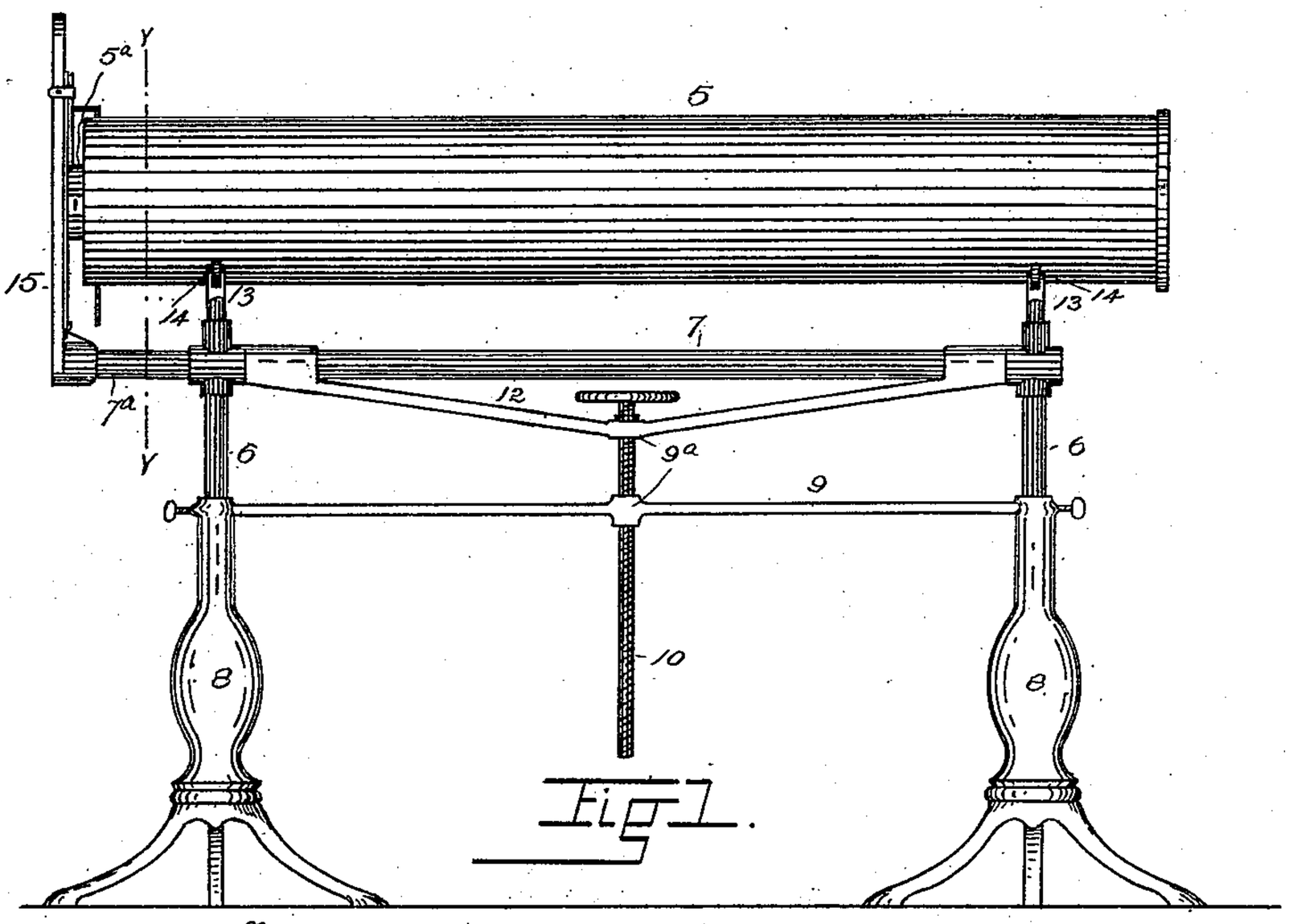

Fig. 1.

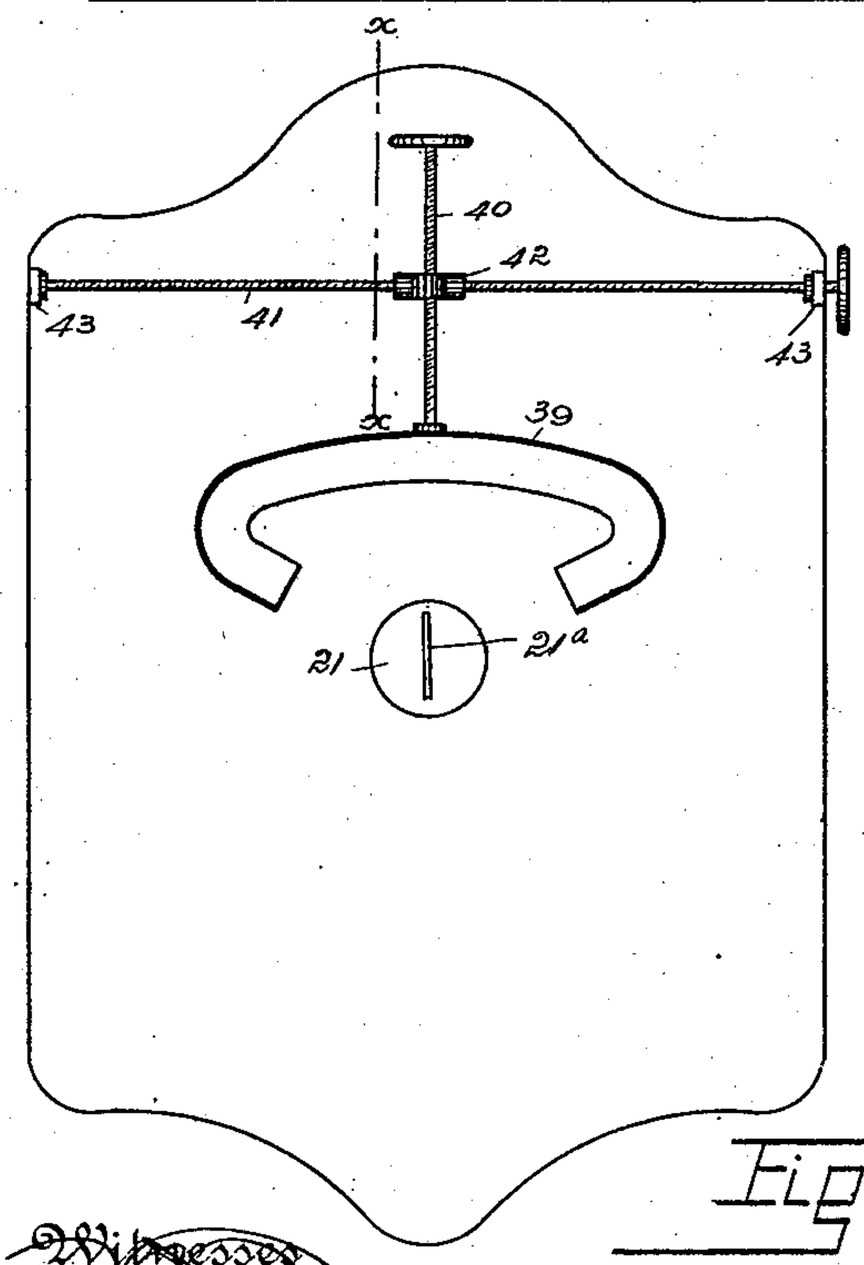

Fig. 2.

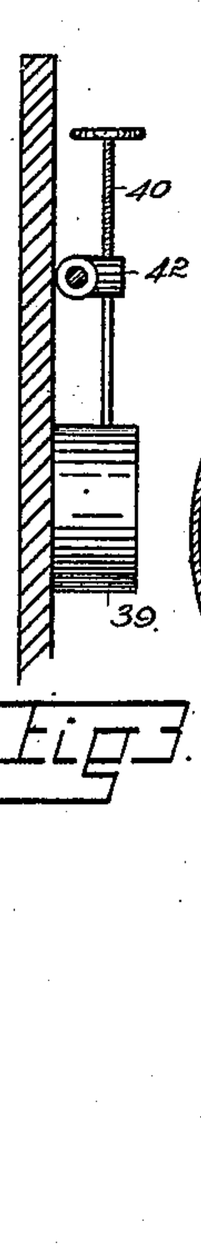

Fig. 3.

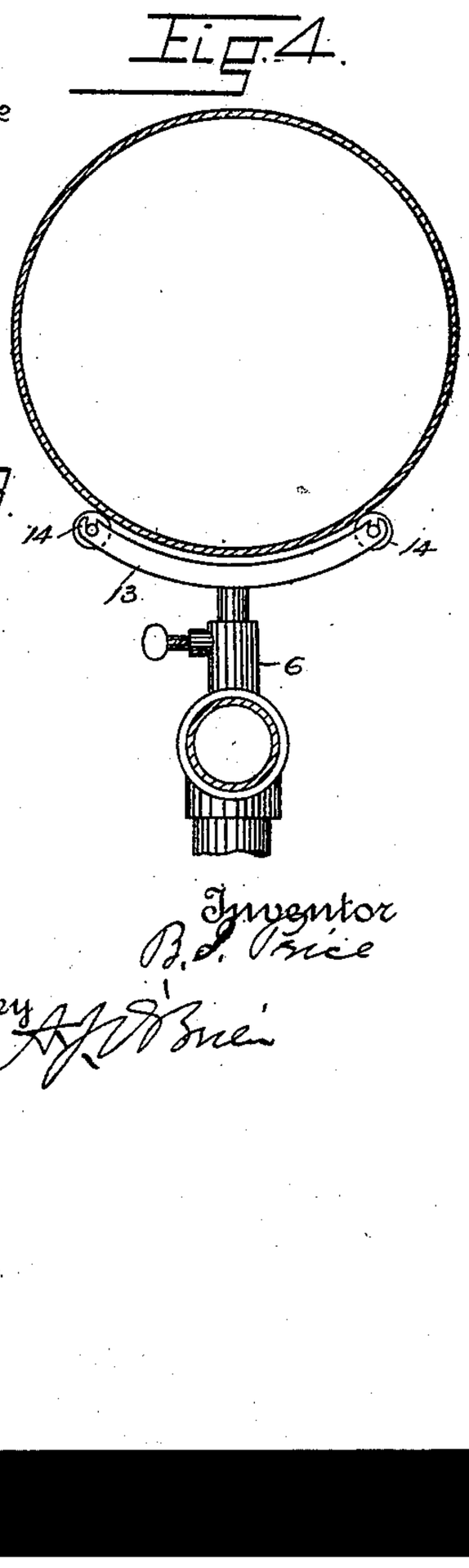

Fig. 4.

Witnesses
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(No Model.) 3 Sheets—Sheet 2.

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No. 534,375. Patented Feb. 19, 1895.

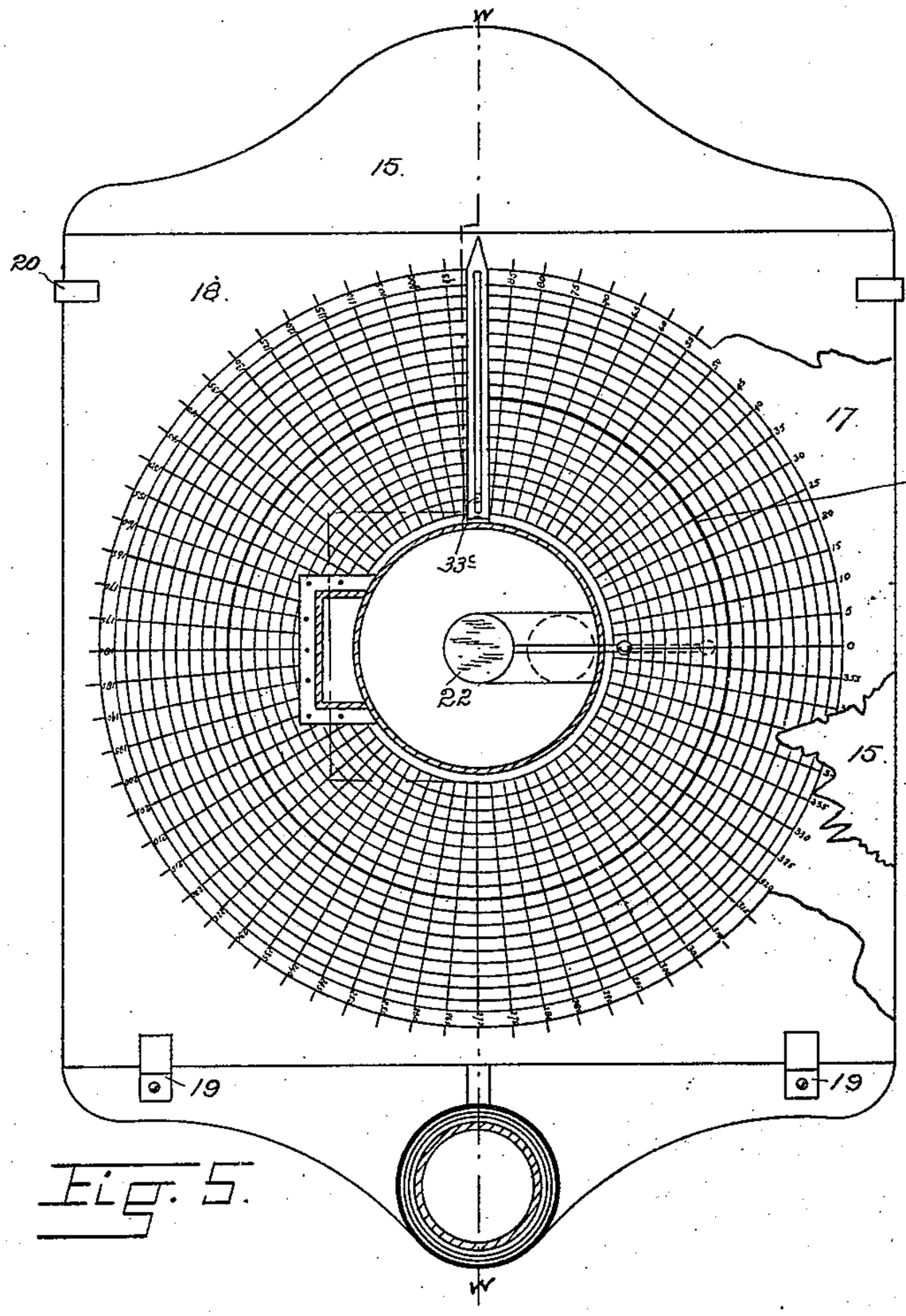

Fig. 5.

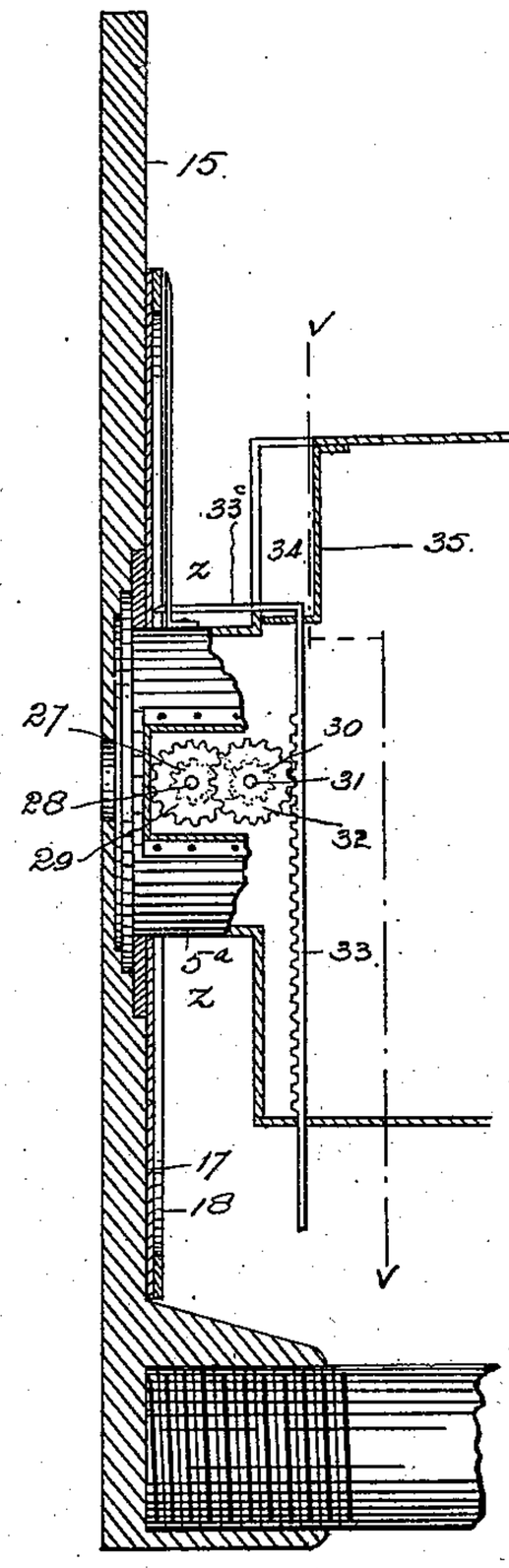

Fig. 6.

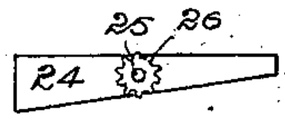

Fig 13.

Fig 16.

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(No Model.) 3 Sheets—Sheet 3.

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OPHTHALMIC INSTRUMENT.

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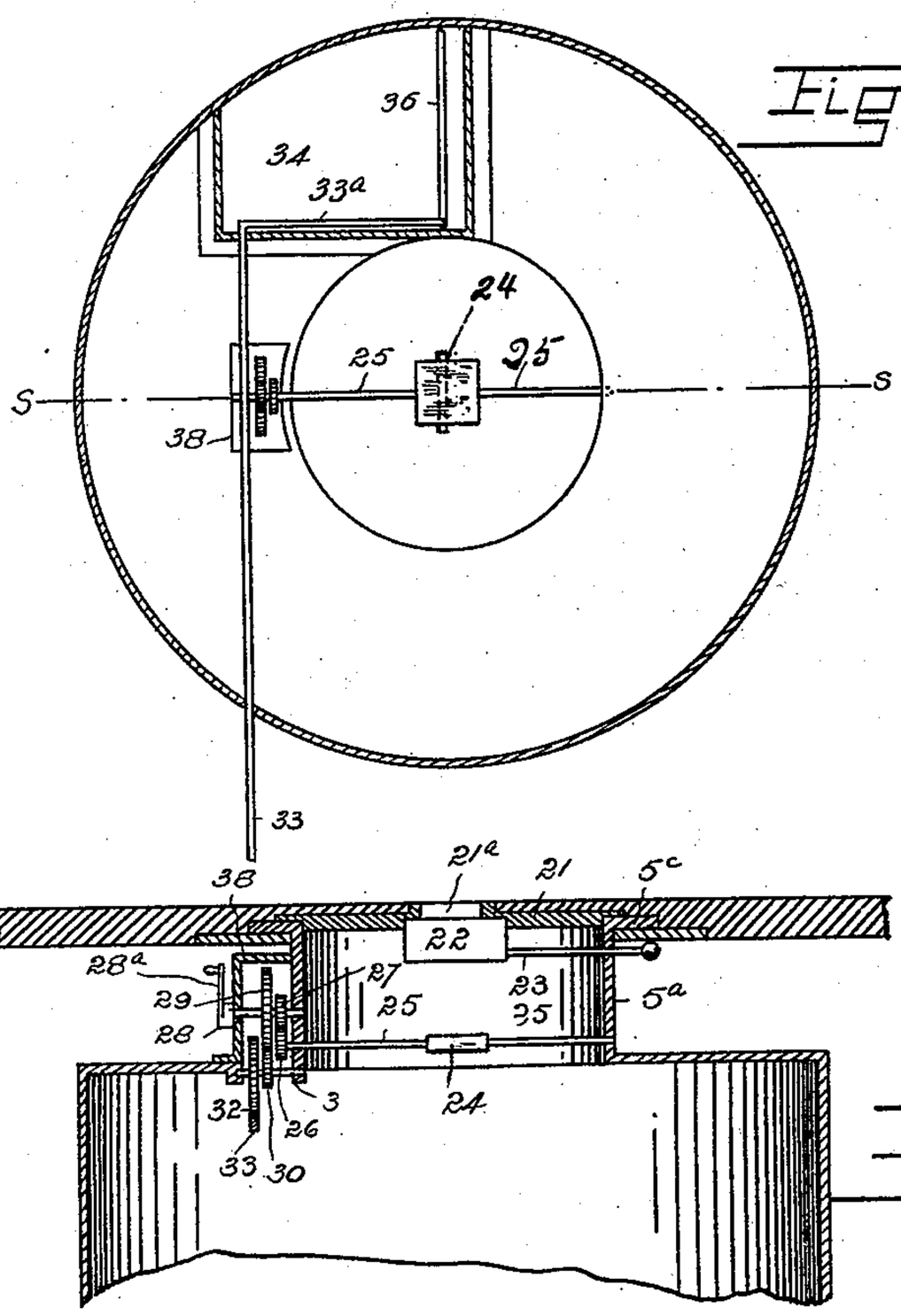

Fig. 7.

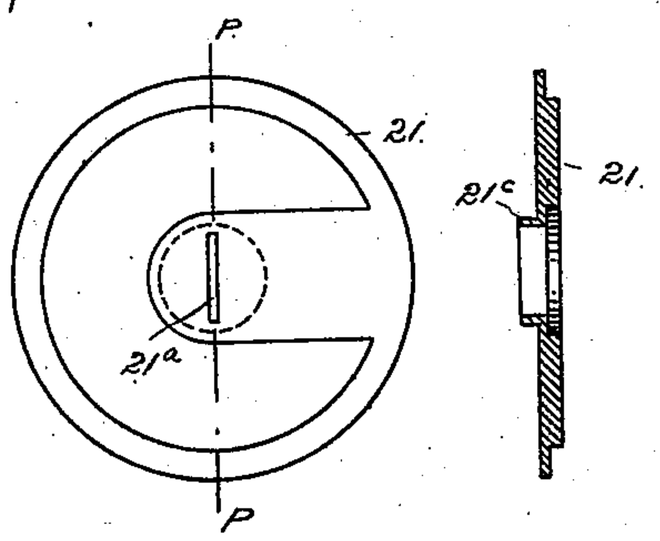

Fig. 11. Fig. 12.

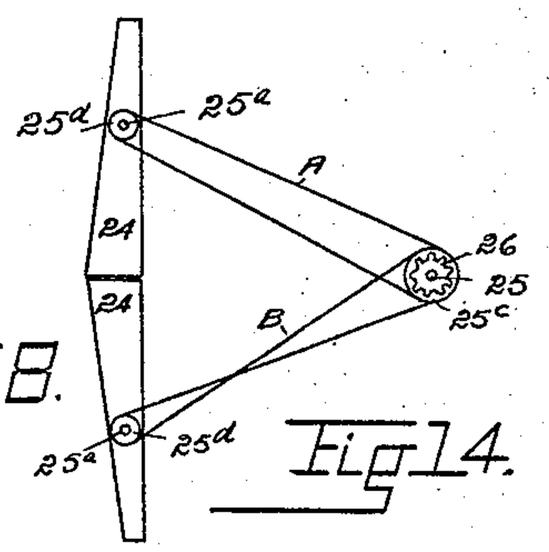

Fig. 8. Fig. 14.

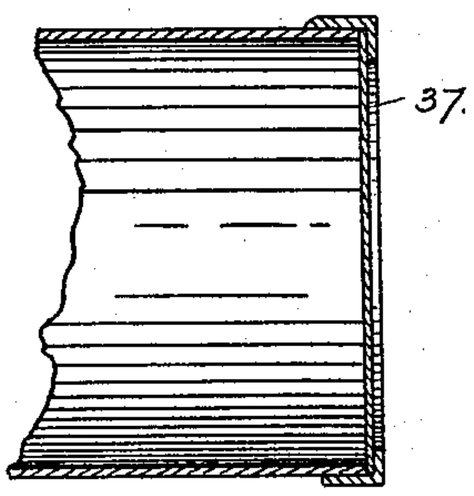

Fig. 10.

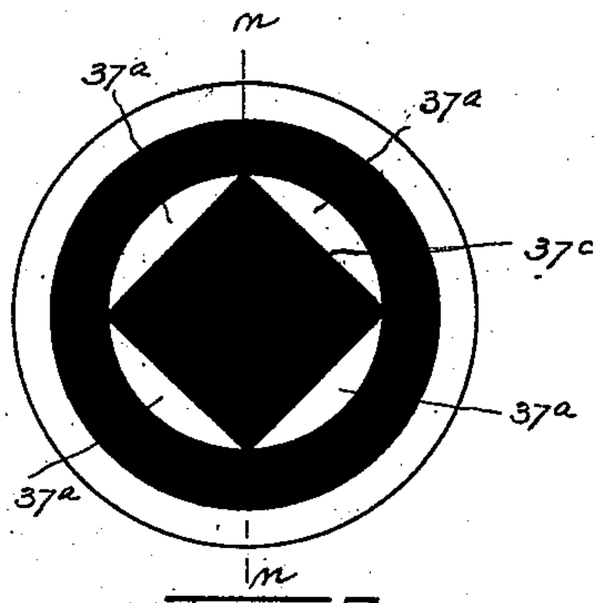

Fig. 9.

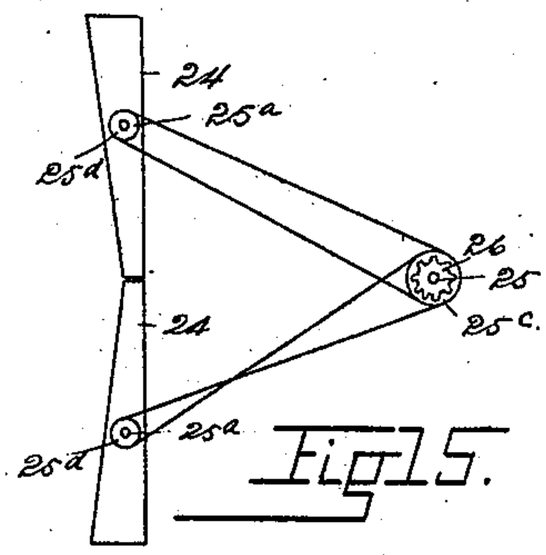

Fig. 15.

WITNESSES:

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ATTORNEY

UNITED STATES PATENT OFFICE.

BENJAMIN I. PRICE, OF DENVER, COLORADO.

OPHTHALMIC INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 534,375, dated February 19, 1895.

Application filed March 14, 1894. Serial No. 503,660. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN I. PRICE, a citizen of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Ophthalmic Instruments; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures and letters of reference marked thereon, which form a part of this specification.

My invention relates to improvements in instruments for ascertaining the abnormal or mechanical defects of the eye, whereby glasses for the correction of these defects may be accurately fitted. For this purpose, I employ one or more prisms mounted in a rotatable tube, with which the prism or prisms used are adapted to turn. The prism is also pivoted in the tube, and adapted to turn on its own center. The use of the prism is to double-image the object formed in the opposite end of the tube, or cause the eye to see two images of this object. An emmetropic or normal eye will see these two objects tangent to each other by virtue of a precise relation between the distance of the object and the position and character of the prisms; while the objects will appear to separate or overlap, according as the eye is myopic or hypermetropic. By rotating the tube, the defects in all the meridians of the eye are ascertained. By turning the prism on its pivot when the tube is still, the degree of the defect in any meridian is ascertained. For instance, if the objects appear to separate, or overlap, in a marked degree at any meridian, this is announced by the patient, and the operator ceases to rotate the tube and turns the prism on its pivot until the objects are made to appear tangent. The degree of the defect in any meridian is thus ascertained by the distance it is necessary to turn the prism before the images are brought together, or tangent to each other, as pictured on the retina.

An important feature of the instrument is a chart attached to the stationary face-plate thereof, and on which is registered the degree of the defective or abnormal condition. In other words, the distance the prism is turned to cause the separated or overlapping objects to appear tangent at any meridian of the eye, is measured and indicated, or registered on the chart. As many of these measurements may be taken as the operator desires, or as may appear necessary. This will undoubtedly depend upon the patient. The chart is composed of circles and radial lines drawn across the circles. The degrees are indicated on the outer circle, there being a radial line for each degree. A registration at the center of any radial line indicates a perfect or normal condition in that meridian. A registration at the center of all the radial lines, or in the circle which bisects all of said lines, indicates a natural or normal condition of the eye in all the meridians. A registration at a point in either direction from the center of any radial line indicates an abnormal condition, myopic or hypermetropic, according to the direction in that meridian; while registrations at different radial lines around the chart, and on circles on one side or the other of the bisecting circle will indicate the abnormal condition, myopic or hypermetropic, in all the meridians of any eye. A separate copy of the chart is used for each patient. This chart is detachable from the instrument, and from it, the proper glasses for any patient may be constructed by one understanding the chart, since the defect of the eye in every meridian, and the degree of the defect, are indicated and registered upon the chart.

If only one prism is used in the instrument, the object looked at will appear double, one image being seen through the prism, and the other through the adjacent space. Either the base or the apex of the prism may be used. To a hypermetropic eye, the two images will appear to separate if the apex of the prism is employed, and to overlap if the base is used; while if the eye is myopic, the reverse will be true. Two prisms may be employed with their bases or apices in contact. The two prisms in contact will give the same result as the single prism. If two prisms in contact are used, an image is seen through each prism. There is one more prism arrangement that may be employed, namely, two separated prisms. In this case, three images of the objects are depicted upon the retina, one being seen through

each prism, and another through the space between the prisms.

Having thus briefly explained the construction of my improved instrument, and the principles upon which it operates, I will now describe the construction in detail by reference to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 is a side elevation of the instrument. Fig. 2 is a front view of the same. Fig. 3 is a vertical section taken through the face plate, on the line *x*—*x*, Fig. 2. Fig. 4 is a section taken on the line *y*—*y*, Fig. 1. Fig. 5 is a section taken on the line *z*—*z*, Fig. 6, the inner surface of the face-plate, to which the chart is attached, being shown in elevation. Fig. 6 is a section taken on the line *w*—*w*, Fig. 5. Fig. 7 is a section taken on the line *v*—*v*, Fig. 6. Fig. 8 is a section taken on the line *s*—*s*, Fig. 7. Fig. 9 is a rear end elevation of the rotatable tube, shown on a smaller scale than in Fig. 8. Fig. 10 is a section taken on the line *n*—*n*, Fig. 9. Fig. 11 is a front view of the eye-piece. Fig. 12 is a section taken on the line *p*—*p*, Fig. 11. Fig. 13 illustrates a single prism. Fig. 14 shows a double prism, or two prisms placed base to base. Fig. 15 shows a double prism, or two single prisms placed apex to apex. Fig. 16 illustrates the manner of using two separated prisms.

Similar reference characters indicating corresponding parts or elements in these views, let the numeral 5 designate a tube of any suitable size, rotatably mounted upon standards 6 connected by a horizontal bar 7, and adapted to telescope in the hollow legs 8, connected by a bar 9 carrying a central nut 9ª which receives a vertical screw shaft 10, swiveled in a yoke 12 whose extremities are made fast to the bar 7. To the upper extremities of the standards 6 are attached curved bars 13 carrying rollers 14 which engage the tube 5, and facilitate rotation by reducing the friction to a minimum.

The bar 7 is provided with a forward extension 7ª to which is attached, and which forms the support for, the vertical head-plate 15. This plate is recessed on its inner surface to receive the reduced flanged extremity 5ª of the tube 5, which is held in place by a collar 16 engaging the flange of the tube, and flush with the inner surface of the plate 15.

The chart heretofore mentioned, and which is designated by the numeral 18, is placed against the inner surface of the head-plate, and retained by the detachable frame 17 provided with an opening large enough to expose the diagram on the chart—composed of the circles and cross radial lines. The frame-plate 18 is held in place by buttons 19 at the bottom, and side clasps 20 at the top, whereby it may be dropped into place, or removed from the top without moving the buttons or clasps. The chart is apertured to receive the reduced extremity 5ª of the tube. In front of this tube extremity, is located the eye-piece 21, composed of a disk provided with a slot 21ª.

The eye-piece is attached to the flanged extremity of the tube 5, and rotates therewith. The inner surface of the eye-piece is fashioned to receive a lens-holder 22 which may be moved to a position in front of the slot 21ª, and drawn away at will. This device carries lenses adapted to prevent the exercise of the involuntary power of accommodation belonging to the eye, and thus expose conditions otherwise latent. This feature is not new, however, in instruments of this class. Hence nothing is claimed thereon. It is only shown for the purpose of making the instrument complete. Hence no detail of illustration or explanation is believed necessary or desirable. The holder 22 is adjusted by means of a rod 23 attached thereto, and protruding through an aperture formed in the reduced part 5ª of the tube.

In the rear of the eye-piece, and in line with its slot, is mounted the prism 24 on the divided spindle 25 journaled in the reduced extremity 5ª of the tube. One part of this spindle protrudes through the wall of the tube extremity and carries a fast pinion or gear 26 meshing with another gear 27 on a spindle 28, which spindle carries a larger gear 29 meshing with a small gear 30 on a spindle 31 also carrying a larger fast gear 32 engaging a movable rack bar 33. To the spindle 28 is attached a crank-arm 28ª. It will thus be seen that by the use of the crank-arm 28ª and the intermediate gears, the prism 24 and the rack bar 33, may be simultaneously actuated.

The gear mechanism is inclosed by a casing 38 made fast to the tube 5, and forming the support for one extremity of the spindle 28. The body of the rack bar is located to one side of the center of the tube. Hence, its upper extremity is provided with a horizontal arm 33ª located in a chamber 34 and extending to a point directly above the center of the prism when the tube 5 is in the position shown in Fig. 7.

The chamber 34 is formed by attaching a plate 35 to the wall of the tube on the inside. The upper extremity of the vertical part of the rack bar passes through an aperture formed in plate 35. To one extremity of the arm 33ª, a pointer arm 33ᶜ is attached, and extends forward through a slot 36 to the chart 17 upon which it is adapted to mark as the tube is rotated. It is by this means that the condition or defects of the eye in all the meridians are registered upon the chart. To the extremity of the tube 5, opposite the head-plate, is attached a glass plate 37 whose surface is painted black to exclude the light, transparent segments 37ª being left, whereby a square figure 37ᶜ is outlined upon the blackened plate.

The front surface of the head-plate of the instrument is furnished with a head-rest or support 39, adapted to engage the forehead

of the patient and steady the head while looking through the slot of the eye-piece, and also adapted to shut out all light from the eye. This head-rest is adjustable, both vertically and laterally, by any suitable means.

In the drawings, the vertical and horizontal rods 40 and 41 are threaded to engage a T-shaped nut 42. The rod 41 is journaled in lugs 43 attached to the head-plate, and the nut 42 is movable thereon. The rod 43 is swiveled to the top of the head-rest, and movable in the nut 42, its upper extremity being provided with a hand wheel.

The object, or figure 37^c is located directly opposite the slot in the eye-piece at the other end of the tube 5. This object, through the instrumentality of the prism 24, appears double, one image being seen through the prism, and the other through the adjacent space. When the prism is properly adjusted, these two images appear tangent to each other when observed by the normal eye. If the eye is defective, the images will appear overlapping or separated. If the apex of the prism is used, that is, if when the object is seen through the apex, the images appear to separate, the hypermetropic condition is indicated; while if the images appear to overlap, the myopic condition exists. If the base of the prism is used, the same results will indicate opposite conditions of the eye. By turning the tube 5, the conditions in all the meridians of the eye are ascertained, while by turning the prism while the tube is still, until the images appear tangent, the degree of the defect in any meridian may be ascertained. This degree is indicated on the chart by the distance the pointer 33 moves from the bisecting circle 17^a during this action of the prism. When the prism is adjusted to indicate the normal condition of a perfect or emmetropic eye, the pointer is at the middle circle 17^a of the chart. Now, as it moves away from the circle, the defective conditions, myopic and hypermetropic, are indicated, according to the direction of the movement, and according as the apex or base of the prism is used.

The arrangement of the gears between the rack 33 and the spindle of the prism is such that a decided movement of the pointer will occur during a slight movement of the prisms.

When two prisms, as shown in Figs. 14, 15 and 16, are employed, each prism is mounted on a separate spindle 25^a journaled in the tube, and separated from the main spindle 25 by means of small belts A and B. Belt A passes from a small pulley 25^c on spindle 25 to another pulley 25^d made fast on the spindle of one of the prisms. The other belt B passes from the same pulley on the spindle 25 and crosses as it passes to the pulley 25^c on the spindle of the other prism. Hence as the main spindle 25 is rotated in the direction indicated by arrow *a*, movement will be imparted to both the prisms in the direction indicated by the arrows *c* and *d*.

In the construction shown in Fig. 16, three images of the object will appear on the plate 37. The two prisms are first so adjusted that to the normal or perfect eye, these images will appear tangent. When, however, the prisms are in this position, the images will appear to overlap or separate, to the imperfect eye. By moving spindle 25, however, the prisms may be so adjusted, that the objects will appear tangent. The movement necessary to effect this adjustment denotes the degree of the defect, whether myopic or hypermetropic; and this movement is registered on the chart 17 in the same manner as when the single prism is used.

In the construction shown in Figs. 14 and 15, two prisms are placed close together. Hence only two images will be seen, the same as when the single prism is used. These images will appear tangent, overlapping or separated, according as the eye is perfect, myopic or hypermetropic; and the degree of the defect is ascertained by the adjustment of the prisms in the manner heretofore explained, when speaking of the construction shown in Fig. 16.

Having thus described my invention, what I claim is—

1. In an instrument of the character described, the combination of the apertured eye-piece, the prism mounted on a spindle, and a rotatable support for the prism spindle, the arrangement being such that the prism has two movements, one on its spindle, and the other by virtue of the movement of the rotatable support in which the spindle is journaled, substantially as described.

2. In an instrument of the character described, the combination of the apertured eye-piece suitably supported, the prism rotatably mounted in front of the aperture in the eye-piece, and a rotatable support for the prism mounting, whereby the prism has two movements, one with the rotatable support, and the other on a spindle journaled in the rotatable support and independent thereof, substantially as described.

3. In an instrument of the character described, the combination with the apertured eye-piece of the double-image prism rotatably mounted in front of the eye-piece, and a rotating support in which the prism mounting is journaled, whereby the prism has two distinct movements, one on its spindle, and the other with the rotatable support carrying the spindle, substantially as described.

4. In an instrument of the character described, the combination of the apertured plate for the eye, a prism rotatably mounted in a rotatable support, whereby it has two movements, the one at right angles to the other, a chart mounted on a stationary support in suitable proximity to the prism, a

pointer adapted to engage the chart, and means for connecting the pointer and prism, whereby the movement of the latter upon its spindle is registered on the chart by the pointer, substantially as described.

5. In an instrument of the character described, the combination of an apertured plate or eye-piece, a rotatable prism mounted in a suitable support, whereby the prism has two independent movements, one on its spindle, and the other with the support carrying the spindle, a suitable figure or object representation located in line with the eye-piece and prism, a chart mounted on a stationary support, a pointer adapted to engage the chart, and means for connecting the pointer and prism spindle, whereby the movement of the prism on its spindle is indicated on the chart, substantially as described.

6. In an instrument of the character described, the combination of a closed rotatable tube suitably mounted, and provided with an apertured eye-piece at one extremity, and an object representation at the opposite extremity, a prism mounted on a spindle journaled in the tube, the prism being in line with the apertured plate and the object representation, a stationary chart attached to the instrument, a pointer engaging the chart, and means for connecting the pointer and prism spindle, whereby the movement of the prism on its spindle is registered on the chart, as and for the purpose set forth.

7. In an instrument of the character described, the combination of a rotatable closed tube suitably mounted, and having an apertured head-plate at one extremity, and a plate carrying an object representation at the opposite extremity, said plate being black except in parts where it is transparent to define or outline the object, a double image prism mounted in the tube, but independently rotatable, a chart attached to the head-plate, a marking pointer or registering device suitably mounted on the instrument, and means for connecting the prism and the marking pointer, whereby the movement of the prism is registered on the chart, as and for the purpose set forth.

8. In an instrument of the character described, the combination of the rotatable tube suitably mounted, and provided with an apertured head-plate at one extremity, and an object plate at its opposite extremity, a chart composed of circles and cross radial lines, a prism rotatably mounted in the tube, and a registering device suitably connected with the prism, and adapted to engage the chart, whereby the movement of the prism is registered on the chart, as and for the purpose set forth.

In testimony whereof I affix my signature in the presence of two witnesses.

BENJAMIN I. PRICE.

Witnesses:
W. G. EDWARDS,
CHAS. E. DAWSON.