H. G. INGRAM & H. R. DERICKSON.

REFRACTOMETER.

APPLICATION FILED FEB. 16, 1912.

1,045,148.

Patented Nov. 26, 1912

2 SHEETS—SHEET 1.

Fig. 2.

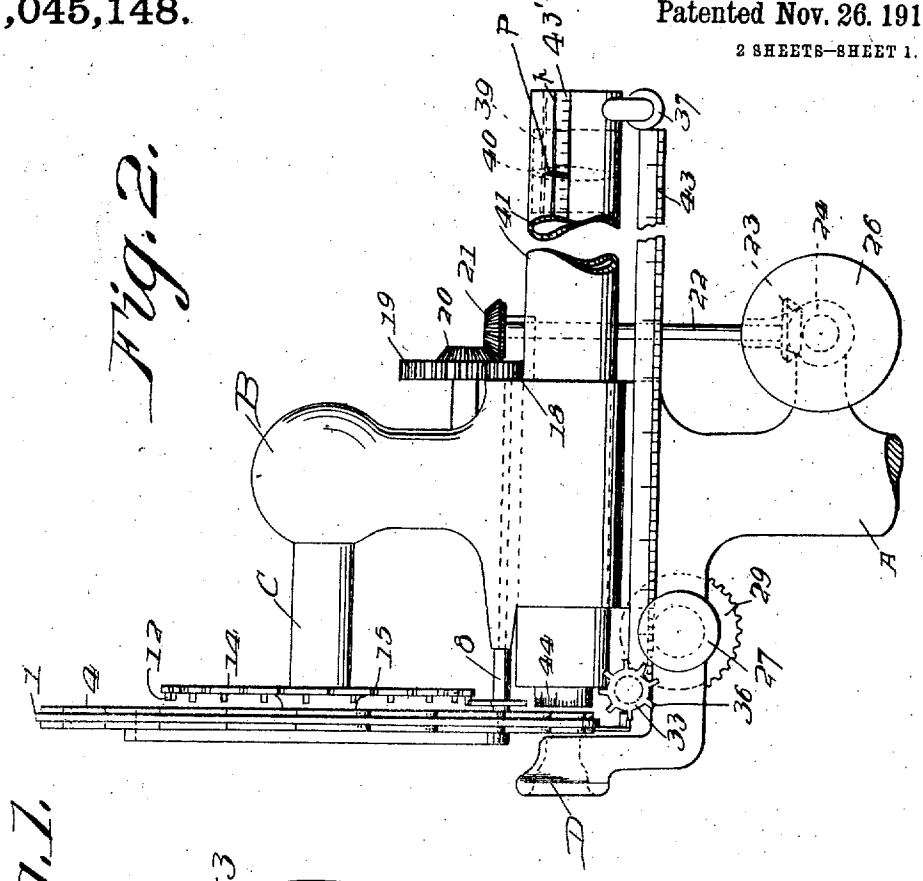
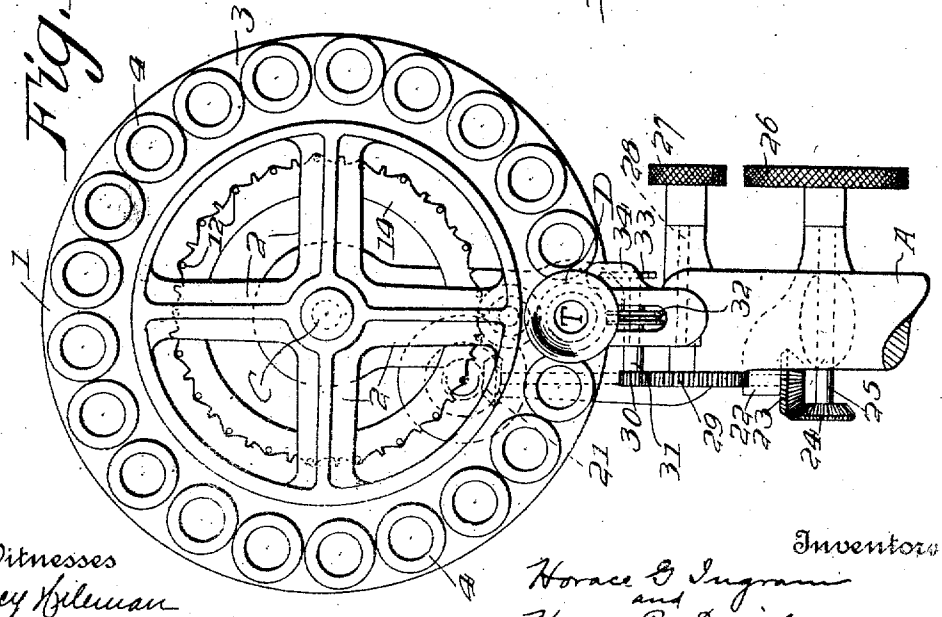


Fig. 1.



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2 SHEETS—SHEET 2.

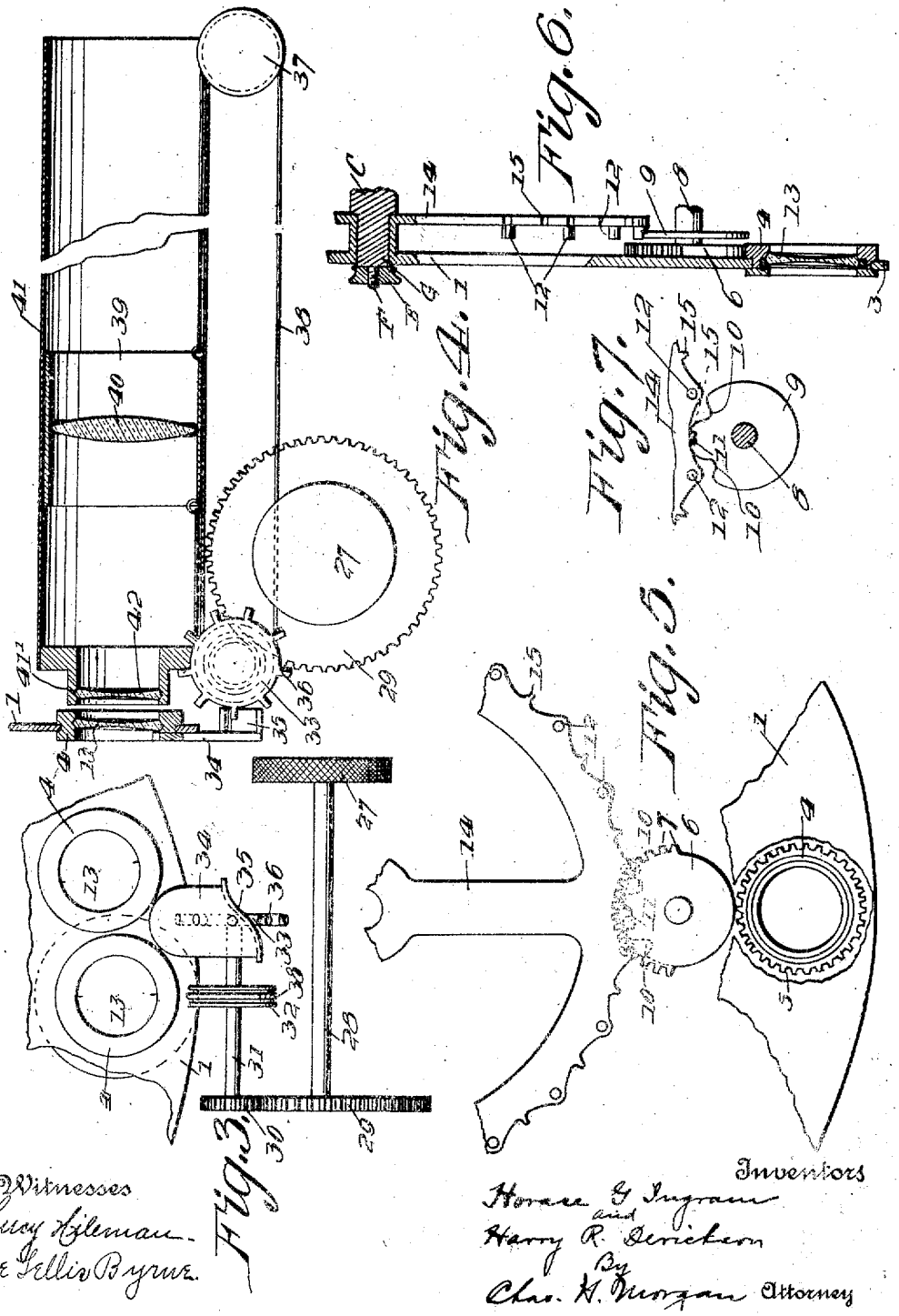

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

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UNITED STATES PATENT OFFICE.

HORACE G. INGRAM, OF JUNIATA, AND HARRY R. DERICKSON, OF ALTOONA, PENNSYLVANIA, ASSIGNORS OF ONE-THIRD TO SAMUEL GOLDBERG, OF ALTOONA, PENNSYLVANIA.

REFRACTOMETER.

1,045,148. Specification of Letters Patent. Patented Nov. 26, 1912.

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To all whom it may concern:

Be it known that we, HORACE G. INGRAM, a citizen of the United States, and a resident of the borough of Juniata, county of Blair, and State of Pennsylvania, and HARRY R. DERICKSON, also a citizen of the United States, and a resident of Altoona, in the county of Blair and State of Pennsylvania, have invented certain new and useful Improvements in Refractometers; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the reference letters and figures marked thereon.

Our present invention has for its object to provide an optical instrument capable of diagnosing and measuring quickly and accurately errors in the refraction of the human eye, which can be used by an oculist, optician or by the ordinary medical practitioner, without the necessity heretofore existing of using an expensive case of test-lenses.

A further object of this invention is to simplify the method of testing for the refraction so that the patient himself can operate the mechanism and get as good results as the optician, and it consists in certain improvements and constructions of parts, all of which will be hereinafter fully described and the novel features pointed out in the claims at the end of this specification.

In the drawings Figure 1 is a front elevation of an instrument constructed in accordance with our invention; Fig. 2 is a side elevation of the same; Fig. 3 is a detail of the mechanism for operating the lens mounted in the tube; Fig. 4 is a side view partly in section of the lens carriers holding the cylindrical lenses; Fig. 5 is a detail of the operating mechanism for moving the disk at regular intervals, and also for partially rotating the lens carriers. Fig. 6 is a sectional view of the mechanism shown in Fig. 5. Fig. 7 is a detail of the mechanism of Fig. 6.

Similar reference letters and figures indicate similar parts throughout the drawings.

The instrument consists of a base "A", having a projection "B" formed integral therewith, and an arm "C" is fastened to said projection "B". Upon the outer end of the arm "C", as shown in detail in Fig. 4, is rotatably mounted a disk "1". The forward end of the arm "C" acts as a pintle upon which the disk rotates, and which is held in place by means of a nut "E" held by a screw "F" on the end of the arm "C". We do not wish to limit ourselves to this particular construction, however, and any form of mounting may be used instead. Another disk "14" is fastened rigidly to the disk "1" and rotates therewith. The disk "1" can be made lighter by cutting out a portion of the center and leaving radial arms "2" projecting from the hub. In this case these arms "2" would preferably be reinforced with ribs, such as are indicated in Fig. 1. This can be omitted, however, without affecting the invention. The annular portion of the disk shown at "3", has a number of circular openings in it, and in these openings are mounted lens carriers "4". They are so mounted as to freely rotate in these openings, and upon the inner side of the lens carriers are fastened gear wheels having teeth "5" around the entire circumference, as shown in Fig. 5. Contiguous to this circle of lenses is mounted a mutilated gear "6", having teeth "7" partly around the circumference. This mutilated gear is mounted upon the end of a shaft "8", and upon the same shaft and concentric therewith, is rigidly fastened a disk "9". This disk has a pin "11" rigidly mounted near its periphery and projecting in a horizontal direction toward the disk "14". The disk "14" has pins "12" also projecting horizontally toward the disk "9", placed at regular intervals around its periphery. It also has projections "15" placed at the same intervals as the pins "12" and at points equally distant from said pins "12". The disk "9" also has depressions "10" notched in its periphery on either side of the pin "11".

From this it will be seen that when the shaft "8" is rotated in either direction, it rotates the disk "9" and the mutilated gear "6". When the pin "11" strikes a projection "15" the notches "10" in the periphery of disk "9" are in exactly the position necessary to permit rotation of the disk "14" by reason of the pins "12" going down into the notches "10", and the disk "14" is, therefore, rotated a fraction of a revolution, equal to the distance between two pins "12". As soon as the pin "11"

slides off the projection "15", the periphery of the disk "9" touches both pins "12", which are contiguous to each other, and for the remainder of the revolution of the disk "9", therefore, the disk "14" is held stationary. While this disk "14" is held stationary the teeth of the mutilated gear "6" strike the teeth "5" of the annular ring "4" and start rotating it. The rotation is continued until the end of the mutilated gear is reached. When the disk "9" has made a complete revolution it leaves the notches "10" again in a position to allow the disk "14" to rotate another sectional portion of a revolution.

From Fig. 1 it can be seen that there are as many segments to the disk "14" as there are lens carriers in the disk "1", so that every time the disk "14" is moved a fractional part of a revolution a new annular ring is brought in line with the eye-piece "D", and as soon as the mutilated gear begins to rotate said annular ring, the direction of the axis of the cylindrical lens mounted in this annular ring is changed so as to move it not less than 180 degrees, thereby giving all of the positions necessary for the correction of astigmatism, when the proper strength of lens is tried. Each of the annular rings "4" mounted in the outer portion of the disk "1" contains a cylindrical lens of different strength and graduated in even proportion so as to give a complete trial of the different cylindrical lenses used for the correction of astigmatism.

The portion of the mechanism used in connection with this machine for the correction of myopia or hypermetropia, consists of a cylindrical tube "41" mounted on the base "A" in any suitable manner. The axis of this tube is directly under the arm "C" and parallel therewith. At the forward end of this tube is mounted a concave lens "42" in a mounting "41′". Slidably mounted within the tube in a carrier "39" is a convex lens "40". This carrier "39" is of such length that it will not bind in the cylinder "41" when pulled in either direction by means of a cord "38". The cord "38" passes through the cylinder from one end to the other and at its forward end is wound on a sheave "32". It is passed over this sheave one and one-half times so as to produce considerable friction and thereby readily move the lens carrier "39". At the rear end of the tube is mounted another sheave "37", about which the cord "38" is taken in the same manner as at the forward end. This sheave "37" preferably has a milled head so that the cord can readily be operated in either direction by hand. At the forward end of the tube is another mechanism which consists of the milled head "27" mounted on the shaft "28", having a gear "29" rigidly fastened at its opposite end. Meshing into this gear "29" is a small gear "30" rigidly fastened to a shaft "31", upon which is also mounted the sheave "32" above referred to. At the opposite end of the shaft "31" is rigidly mounted a wheel "33" having projecting pins "36". From this it will be seen that by the rotation of the hand wheel "27" the lens carrier "39" is readily moved into any position along the axis of the tube. A scale "43", such as is shown in Fig. 2, is mounted adjacent to the cord "38", and by fastening an indicator on the cord, the position of the lens is readily indicated and the different combinations formed by the two lenses "40" and "42" are readily determined.

A pointer and scale can also be used direct on the tube "41". Such a pointer is indicated at "P" Fig. 2, and the scale "43′". This pointer is fastened to the lens carrier "39" and passes through a slot "*p*" in the tube "41". From this it will be seen that reading can be taken off of either the scales "43" or "43′".

Upon the outer edge of the disk "1" is fastened a projection "34", having a cam surface "35" of substantially the shape shown in Figs. 3 and 4, projecting from its outer edge. This cam surface is so attached as to strike one of the pins "36" when the disk "1" is rotated and operated so as to move the wheel "33" a fraction of a revolution upon each revolution of said disk "1". A circular scale is also formed upon the outer surface of the mounting "41′" and a notch or projection is formed on the annular ring "4" in the direction of the axis of the cylinder, so that a reading of the number of degrees from the vertical or horizontal can readily be taken when the instrument has been properly adjusted to fit the eye of the patient.

An eye-piece "D" is preferably formed upon the support "A" and placed in direct alinement with the axis of the cylinder "41." It is also to be noted that one of the annular rings "4," shown in Fig. 1 as "T," is left without a lens or is provided with a plane glass, and this is located next to the cam "35."

The operation of the mechanism is as follows:—The disk "3" is rotated until the annular ring "T" comes before the eye-piece "D." The person whose eyes are to be tested then looks through the tube and by means of the hand wheel "27" moves the lens "40" backward or forward as the case may be, until the object at which he is looking, and which is placed at the proper distance from the instrument, is in the position of clearest vision. He then begins to operate the hand wheel "26," which is connected by a shaft "25" to the bevel-gears "23" and "24." The gear "23" is mounted upon a shaft "22" which, by means of bevel-gears "20" and "21"

operates a large gear "19." The gear "19" in turn operates a similar gear "18" mounted upon a shaft "8," and upon this shaft "8," as above described, is mounted the disk "9" and mutilated gear "6." This disk "9" holds the disk "1" in position until the pin "11" strikes a projection "15," when the depressions "10" in the disk "9" allow movement of the wheel "14" until it has turned through a portion of a revolution equal to the distance between two consecutive pins "12." While said disk "1" is held stationary the shaft "8" is rotating and the mutilated gear "6" operates the annular ring "4" through the gear teeth "5." This tries the correction for astigmatism, and if the spherical ametropia is properly corrected by the lenses in the tube, the degree of astigmatism is determined by one of the lenses mounted in the annular rings "4." If the first lens is not of sufficient strength to properly correct the cylindrical ametropia, the operator continues to rotate the hand wheel "26" thereby bringing alternately each successive cylindrical lens into the axis of the cylinder "41," and rotates said lens a distance of at least 180 degrees, thereby bringing it into all possible positions for the correction of astigmatism. As soon as the proper strength of cylindrical lens is reached, the operator turns it to the right angle at which vision is clearest and by reading the scales "43" and "44" it is readily determined what strength of lens is required, and also the position in which the axis of the cylinder is placed for correcting astigmatism. By numbering the lenses, mounted in the annular rings or carriers "4," the strength of the cylinder necessary for the correction is also known. Either plus or minus cylinders can be used as required.

From this description it will be seen that the mechanism is compact and complete in all its details for obtaining a correct refraction of the eye in the quickest way possible, consistent with accuracy.

We do not wish to limit ourselves to the means of moving the lens "40" in the tube "41," but any form of mechanism accomplishing this same purpose may be used.

It is also to be understood that we do not wish to limit ourselves to the specified form of intermittent movement used in this case for intermittently rotating the disk "1," and also the lens carriers "4." Any form of intermittent movement for this purpose may be used.

We claim as our invention.

1. In a refractometer the combination of a fixed tube having a lens fixed at one end, a movable tube carrying another lens, a scale and pointer for determining the relative distance of these two lenses, means for moving said tube, a disk mounted with its axis parallel to the axis of the fixed tube, lens carriers in said disk having lenses of varying strengths and means for rotating said disk and lens carriers, so as to bring the lenses in axial alinement with the axis of the fixed tube and then rotating the lens carriers each on its own axis.

2. In a refractometer the combination of a fixed and movable tube, a lens in each of said tubes, a disk rotatably mounted at right angles to the axis of said tubes, a series of lens carriers carried in the outer portion of said disk, and means for rotating both said disk and lens carriers each on its own axis.

3. In a refractometer the combination of a fixed and movable tube, a lens in each of said tubes, a disk mounted on an axis parallel to the axis of the tubes, a series of lens carriers rotatably mounted in said disk, teeth on the edge of said lens carriers, a mutilated gear engaging the teeth on the lens carrier for a portion of a revolution, means for holding the disk stationary while the lens carrier is being rotated, and means for moving the disk a fraction of a revolution and means for changing the relation of the first two lenses after a complete revolution of the disk.

4. In a refractometer the combination of an adjustable lens, a series of cylindrical lenses, means for moving the cylindrical lenses and rotating them in the axis of the adjustable lens and mechanism for holding the parts in proper relation to each other.

5. In a refractometer the combination of a fixed concave lens, a movable convex lens, a disk containing a series of cylindrical lenses, means for rotating said cylindrical lenses and also for rotating the disk at regular intervals.

6. In a refractometer the combination of a tube, a fixed concave lens at one end of the tube, a movable convex lens in the tube, a mechanism for moving said convex lens, a disk containing a series of cylindrical lenses, means for rotating said disk at regular intervals, and also for rotating the cylindrical lenses.

7. In a refractometer the combination of a tube, a fixed concave lens at one end of the tube, a movable convex lens mounted slidably in said tube, a mechanism for moving said lens, an indicator and scale for reading the relative distances of the two lenses, a disk rotatably mounted upon an axis, a series of lens carriers rotatably mounted at regular intervals in a circle near the outer edge of said disk, and a mechanism for rotating said disk at regular intervals, and means operated by this mechanism for rotating the lens carriers a portion of a revolution.

8. In a refractometer the combination with the telescoping tubes and the objective and lens carried thereby, of a disk mounted on an axis parallel with the tube, a hand

wheel and mechanism for rotating and holding the disk alternately, lens carriers rotatably mounted in the outer portion of the disk, gear teeth on the lens carriers and a mutilated gear mounted on the above mechanism for engaging the teeth of the lens carrier while the disk is held stationary.

9. In a refractometer the combination with the telescoping tubes and the objective and lens carried thereby, of a mechanism for operating the lens by hand, a disk mounted on an axis parallel with the tube, a hand wheel and mechanism for rotating and holding the disk alternately, lens carriers rotatably mounted in the outer portion of the disk, gear teeth on the lens carriers and a mutilated gear mounted on the above mechanism for engaging the teeth of the lens carrier and rotating it while the disk is held stationary, and a cam mounted on the disk for engaging the mechanism and moving the lens in the tube once during each complete revolution of the disk.

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