(No Model.)

A. A. TROWBRIDGE.

OPTOMETER.

No. 262,151. Patented Aug. 1, 1882.

Fig. 2.

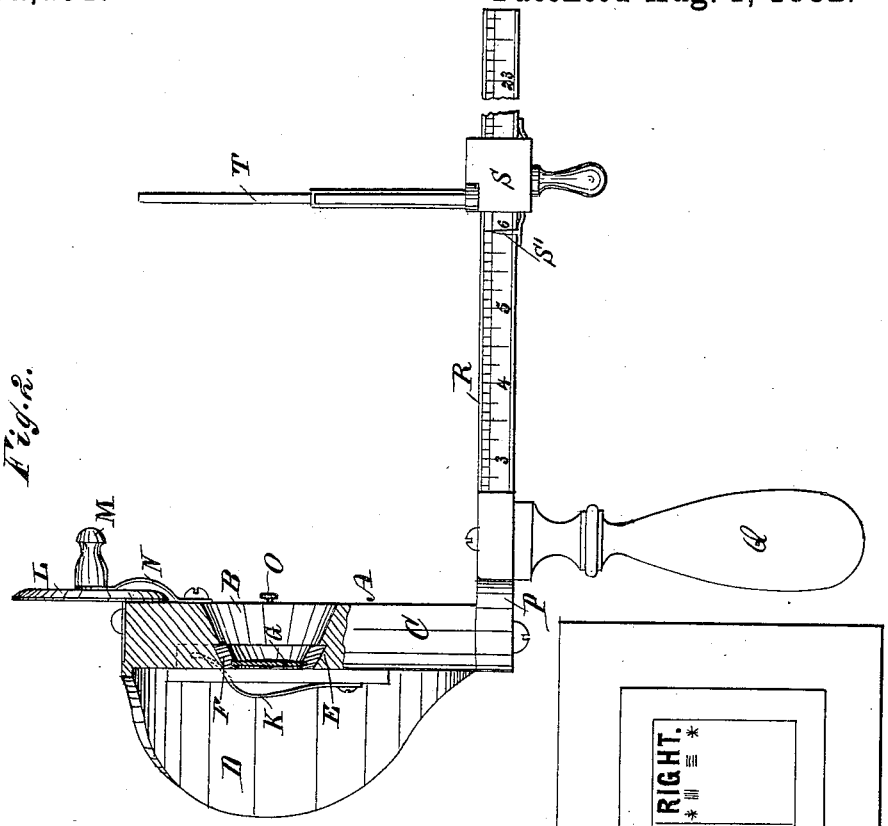

Fig. 3.

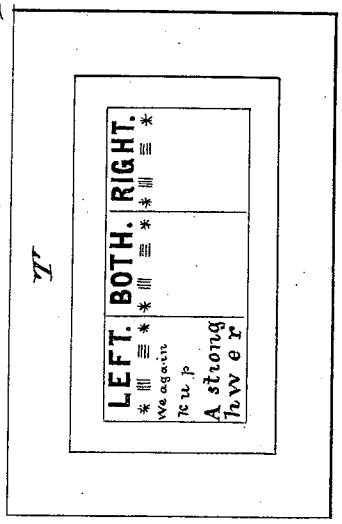

Fig. 1.

WITNESSES:

Thos. G. Hoster

C. Sedgwick

INVENTOR:

A. A. Trowbridge

BY Munn & Co.

ATTORNEYS.

UNITED STATES PATENT OFFICE.

ALFRED A. TROWBRIDGE, OF DANBURY, CONNECTICUT.

OPTOMETER.

SPECIFICATION forming part of Letters Patent No. 262,151, dated August 1, 1882.

Application filed October 25, 1881. (No model.)

To all whom it may concern:

Be it known that I, ALFRED A. TROWBRIDGE, of Danbury, in the county of Fairfield and State of Connecticut, have invented a new and Improved Optometer, of which the following is a full, clear, and exact description.

The object of my invention is to provide a new and improved device for ascertaining the proper correction or remedy for defects of sight that can be corrected or remedied by either convex or concave spherical lenses.

Reference is to be had to the accompanying drawings, forming part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a longitudinal elevation of the outer side of the slide-holding plate. Fig. 2 is a cross-sectional elevation of the same, the hood and the scale-rod being shown in longitudinal elevation. Fig. 3 is a longitudinal elevation of the type or sight card.

The plate A is provided with two apertures, B B, the centers of which are on a horizontal line, and are of such a diameter and distance apart that the portion of the plate between the two eye-apertures will not obstruct the vision of the type-card when it is at its nearest point on the scale. The plate A is also provided with a vertical nose-opening, C, between and below the apertures B B, thus permitting the plate A to be held closely against the face, the nose passing into the opening C. A hood, D, made of leather, veneers, or other suitable material, and fitting closely against the face, is attached to the plate A, and serves to exclude the light from the inner side of the plate A when the same is held in front of the eyes. A dovetailed groove, E, in the inner surface of the plate A, crosses the apertures B, and is adapted to contain reversible slides F, having beveled edges. These slides each have a twelve-inch-focus convex lens, G, in one end, and an opaque disk, H, with a minute central aperture, J, in the opposite end. A line, *a*, is drawn transversely across each end of each slide F in such a manner that these lines will cross the central aperture, J, and the middle of the lens G. The lines *a* are drawn on the slides only, and on the surfaces toward the outer side of the plate A. A spring, K, is provided at each end of the plate A for holding the slides F and preventing them from falling out of the grooves E. The apertures B are beveled from the inner toward the outer side of the plate A, as shown in Figs. 1 and 2, and the bevel is provided with a series of subdividing marks or lines, *b*, by means of which the slides F can be adjusted in the proper position on the plate A, and the distance between the centers of the eyes measured. A disk or shield, L, of sufficient size to cover one of the apertures B, is provided with a handle, M, and is fastened to a spring-strip, N, pivoted to the outer side of plate A between and above the apertures B, so that either aperture B can be closed by means of this disk or shield L. A check-pin, O, is arranged between the two apertures B B. The plate A is attached to a frame, P, provided with a handle, Q. A rod, R, projects from the frame P in the direction from the outer side of the plate A, and this rod R is provided with an inch-scale, or may be provided with any other suitable scale indicating numbers of lenses. A sliding card-carrier, S, provided with a pointer, S′, is loosely mounted on the rod R, and carries the type or sight card T, which is divided into three vertical rows, and has types of different sizes and horizontal and vertical lines in each row.

The instrument is used in the following manner: Either both eyes are tested together or each alone. In order to test the eyes properly, the centers of the lenses in the slides should be exactly before the centers of the eyes when they are looking at the test-object. To obtain this position of the lenses the slides F are placed in the groove E in such a manner that the opaque disk H will appear in the corresponding aperture, B. Then the instrument is held closely and firmly to the face, and one slide is adjusted so that the left-hand column of the sight-card T can be seen plainly and without difficulty through the aperture J. The other slide is adjusted in a like manner for the other eye. Then the positions of the marks or lines *a* in relation to the marks or lines *b* are noted, and the slides reversed so that the marks *a* of the lenses will have the same position in relation to the marks or lines *b* that the marks *a* of the opaque disk H had. Then each eye can be tested singly by simply

closing the other aperture B by means of the disk or shield L, and the eye not being tested should not be closed. It is important that both eyes should be kept open when they are tested singly, because the muscular effort or strain that is necessary to keep one eye closed and the other open requires an amount of attention that disturbs the judgment as to the accuracy with which the test-object is seen. The card-carrier S is then adjusted on the scale so that the pointer S′ shall point or stand at 12, and the instrument is then held closely to the face. If, when one or both eyes are being tested, the finest print on the test-card T can be distinctly and plainly read as far away as twelve and as close as four and a half inches, the eyes are not defective enough to require the aid of glasses. If the eyes cannot see the finest type easily and distinctly at both these distances, the eyes are defective and require the aid of glasses. If the type cannot be read as close as four and a half inches, but must be moved farther away in order to read it plainly and easily, the eyes require a convex glass to correct them. If the finest type cannot be read easily and distinctly as far away as twelve inches, but must be moved nearer, the eyes require a concave glass to correct them. The power and kind of the lens that is required in each case are shown by a table furnished with the optometer, which table reads as follows:

Convex.						Concave.	
Finest Type.		Medium Type.		Largest Type.		Finest Type.	
Scale No.	Lens No.	Scale No.	Lens No.	Scale No.	Lens No.	Scale No.	Lens No.
	5		5	18	5	3	4
	6		6	12	6	3½	5
	7		7	10	7	4	6
	8	17	8	8	8	4⅜	7
18	9	14	9	7	9	4⅝	8
15	10	12	10	6⅝	10	5⅛	9
13	11	11	11	6¼	11	5⅜	10
12	12	10	12	6	12	5⅝	11
11	13	9½	13			6	12
10½	14	9	14			6¼	13
10	15	8⅝	15			6⅜	14
9½	16	8¼	16			6⅝	15
9¼	17	8	17			6⅞	16
9	18	7⅝	18			7⅛	17
8½	20	7½	20			7⅜	18
8¼	22	7¼	22			7⅝	20
8	24	7⅛	24			7⅞	22
7⅞	26					8	24
7⅝	28					8⅛	26
7½	30					8⅜	28
7⅜	32					8½	30
7¼	36					9	36
7⅛	40					9¼	40
7	42					9½	48
6⅞	48					10	60
6⅝	60					10¼	72
6½	72					10½	84

The method of ascertaining by the above table the kind and number of the lens that is indicated by the optometer may be illustrated in the following manner: If, after making the necessary adjustment of the optometer for testing the eyes, as is above explained, it is found that the finest type cannot be read as far away as twelve inches distinctly and easily, it indicates that a concave glass is required, and the power or number of the concave glass may be found by noting the position of the pointer on the scale when the card is removed to the farthest point at which the eyes can see the finest type distinctly. When this point on the scale has been determined, then refer to the column of figures on the table under the word "concave," and the number of the required correcting-glass will be the one in the right-hand column that is opposite the figures in the left-hand column that corresponds to the position of the pointer on the scale—that is to say, if the pointer stands at 3 inches when the card is moved to the farthest limit of distinct sight the required correcting-lens would be No. 4, the one opposite 3 inches on the table under the concave column. If the pointer stands at 5⅜ inches, the number of the required correcting-lens would be 10; if at 9 inches, the required lens would be No. 36, &c. (See table.) If the type cannot be read distinctly and plainly as close as four and a half inches, it indicates that a convex glass is required, and the power or number of the convex glass may be found by noting the position of the pointer on the scale when the card is moved to the nearest point of plain and distinct sight. When this point on the scale has been determined, then refer to the column of figures on the table under the word "convex", and the number of the required correcting-glass will be the one in the right-hand columns opposite the figures in the left-hand columns that correspond to the positions of the pointer on the scale.

It will be noticed that in the convex column there are three columns of lens-numbers and three columns of numbers at the left that correspond to the scale-numbers. This arrangement is made necessary, because in those cases where the card must be moved farther away than twelve inches the finest type on the card will be too small to be seen plainly, and the next-sized type, or, in extreme cases, the largest type at the top of the card, is the only type that can be seen distinctly. If the largest type on the card is the only size that can be seen distinctly, then the number of the required correcting-glass will be the one in the convex column under the words "largest type" that stands opposite the number in the left-hand column that corresponds to the position of the pointer on the scale when the card is moved to the nearest point at which this largest-sized type can be seen distinctly—that is to say, if the largest type cannot be seen closer than eighteen inches the required correcting-glass will be No. 5. If six inches is the closest point, then No. 12 is the required glass, &c. (See table.) If both the largest and medium sized type can be seen distinctly, but the smallest cannot, then the required correcting-glass will be the one in the convex column under the words "medium type" that stands opposite the number in the left-hand column that corresponds to the position of the pointer on the scale when the card is

moved to the nearest point at which the medium-sized type can be read distinctly. If all the different-sized types on the card can be read distinctly, then the number of the required correcting-glass will be the one in the convex column under the words "finest type" that stands opposite to the number in the left-hand column that corresponds to the position of the pointer on the scale when the card is moved to the nearest point at which the finest type can be read distinctly. If the closest point at which the finest type can be read distinctly is at seven and one-eighth inches, the table will show the number of the required correcting-glass to be 40. If the nearest point with the finest type is nine inches, then the number of the glass will be 18, &c. (See table.) The number of the proper correcting-glasses having been determined, it is essential, in order to make them most effective, that their centers should be properly placed before the centers of the eyes. In order to do this accurately, the distance between the centers of the eyes must be measured, and the frames that hold the correcting-lenses should be so adjusted or shaped that when applied to the face the centers of the lenses will be the proper distance apart before the eyes.

To measure the distance between the centers of the eyes with the optometer, the slides F are placed in the groove E in such a manner that the opaque disks H H will appear in the corresponding apertures, B B. Then the instrument, after removing the test card from the carrier, is held closely and firmly before the eyes, and the slides are so adjusted that each eye can see the same far-distant object through the corresponding apertures, J J, without changing the direction or position of the optometer, but by moving the slides F in the groove E until the apertures J J are in such a position before the eyes that each eye can see the same far-distant object through the corresponding apertures, J J, the position of the head and optometer remaining unchanged. When this is done the positions of the marks or lines *a* in relation to the marks or lines *b* are noted, and the distance apart of the centers of the eyes is measured in inches and parts of inches by the lines *b*. If the lines *a* of the slides F stand at the line 2 of the lines *b*, the distance apart is two inches. If the lines *a* of the slides F stand at $2'$, the distance apart is two and one-fourth inches; if at 2^2, the distance is two and two-fourths inches; if at 2^3, the distance is two and three-fourths inches. If the line *a* on one of the slides F should stand at the line 2 of the lines *b*, and the line *a* of the other slide should stand at the line 2^2 of the lines *b*, their distance apart may be determined by adding 2 to 2^2, ($2+2^2=4^2$,) and dividing the result by $2'$, ($4^2 \div 2 = 2'$,) or two and one-fourth inches. The same formula applies in all instances where the lines *a* of the slides F do not stand at corresponding lines of the lines *b*.

The usefulness of the hood D is very great when the optometer is used to test the optical defects of the eyes, or when used to measure the distance between the centers of the eyes, for if the optical defects of the eyes are being tested it excludes all rays of light from the eyes except those which come from the test-card, and if the instrument is used to measure the distance between the eyes the hood excludes all rays of light except those that come through the apertures in the disks.

In place of the shield or disk L, constructed as described, any other suitable device may be used for closing either one of the apertures B.

It is important that there should be three subdivisions or columns of types or figures on the card T, as by this arrangement the eyes can be tested when looking straight ahead, or when both eyes are directed toward the same near object.

It will be observed that the sliding lens-holders F have a lens in the end of each slide, near the back surface of the slide, and at such a distance from the end of the slide that when the slides are placed in the grooves of the face-plate and brought end to end in the groove the centers of the lenses will not be farther apart than two inches. The eye-apertures of the face-plate are made of such a diameter and placed at such a distance apart that when the slides F are placed in the groove E, so that the centers of the lenses in the slides are either two or two and three-quarters inches apart, or at any intervening distance, the front surface of the slides will entirely cover the eye-apertures and prevent the entrance through the apertures of any light except that which passes through the lenses in the slides.

Frames carrying lens-holding slides have been used before; but I claim that none have been used which will accomplish the double purpose of preventing the entrance into the eye through the frame of all light except that which passes through the lenses, and at the same time allow the slides to be adjusted to any distance apart, in order to bring the centers of the lenses in the slides before the centers of the eyes of the person whose sight is being tested.

To increase the efficiency of the instrument, the ends of the slides F, which hold the lenses, are rounded and beveled, and the lens is placed near the back surface of the slide, thus permitting the eyes to be held close to the lenses, the nose passing under and between the slides into the space made by the rounding and beveling of their ends.

Having thus described all that is necessary to a full understanding of my invention, what I claim as new is—

1. In an optometer, the combination, with an eye-apertured face-plate, A, one of the lens-holders F, adapted to slide back and forth in said face-plate, substantially as and for the purpose set forth.

2. In an optometer, the combination, with an eye-apertured face-plate, A, and lens-holders F, sliding in said face-plate, of the shield L, the hood D, the frame P, scale R, and adjustable carrier S, substantially as and for the purpose set forth.

3. In an optometer, the combination, with the face-plate A B C, provided with the marks *b*, the shield D, and the devices F G H, provided with the marks *a*, of the frame having the handle Q, the scale-rod R, and the sliding card-carrier with pointer S′, substantially as and for the purpose set forth.

4. In an optometer, the combination, with the plate A, provided with eye-apertures B, and with marks or a scale, *b*, in the edges of the apertures, of the sliding frames F, containing a lens, G, and an apertured disk, H, and provided with a mark, *a*, at each end, substantially as herein shown and described, and for the purpose set forth.

5. In an optometer, the slide F, constructed substantially as herein described and shown, with a lens, G, at one end and an apertured disk, H, at the other end, as set forth.

6. In an optometer, the slide F, provided with a lens, G, at one end and an apertured opaque disk at the other end, and with a mark or line, *a*, at each end, these marks corresponding with the centers of the lens and disk, respectively, substantially as shown and described, and for the purpose set forth.

ALFRED A. TROWBRIDGE.

Witnesses:

WINFIELD C. BARRY,

CHARLES A. HODGE.