March 31, 1936. A. THOMAS 2,035,773

PHOTOELECTRIC APPARATUS

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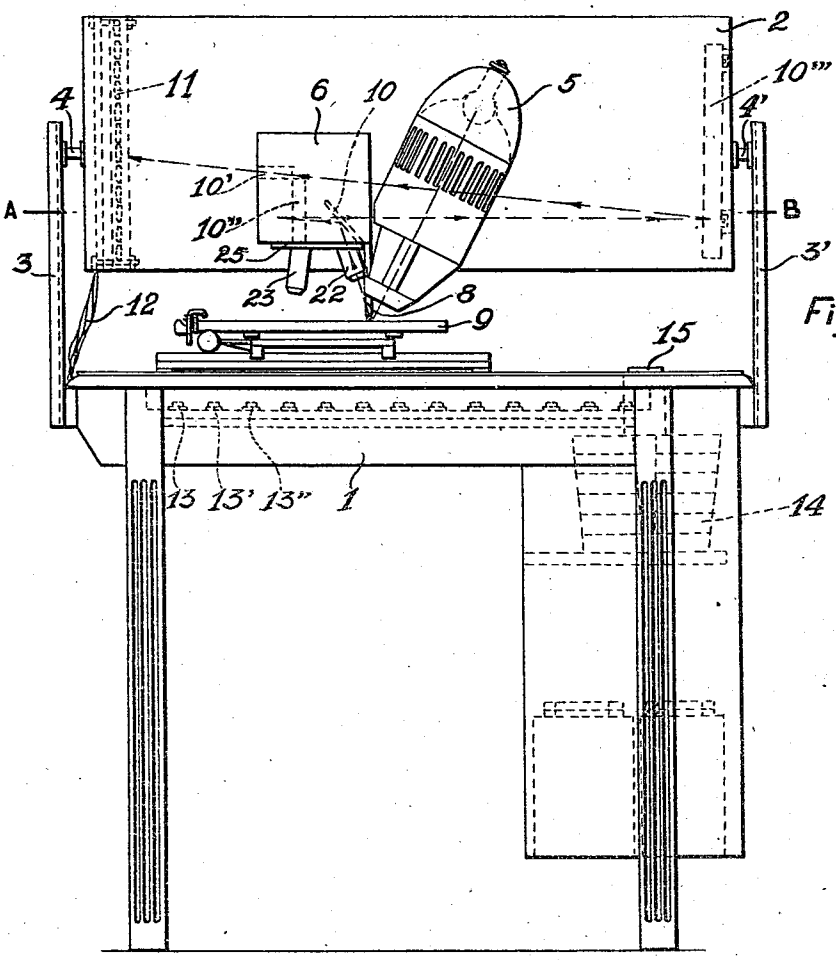


Fig.1.

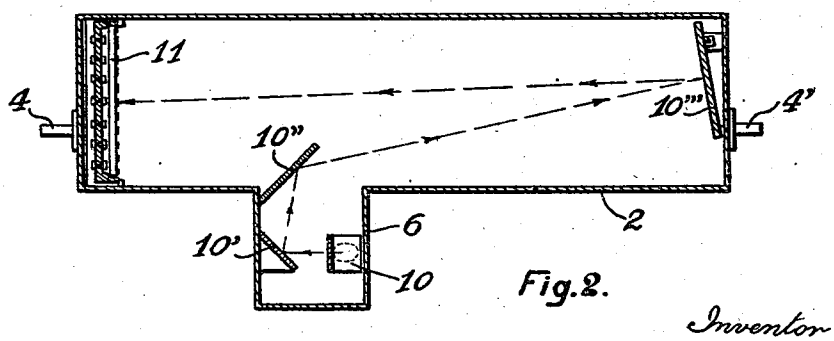


Fig.2.

Inventor
Albert Thomas
by B. Singer
Attorney

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Fig.3.

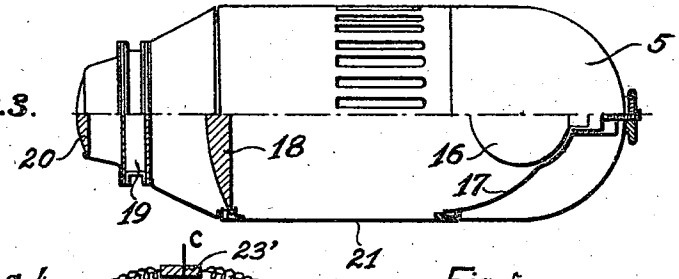


Fig.4.

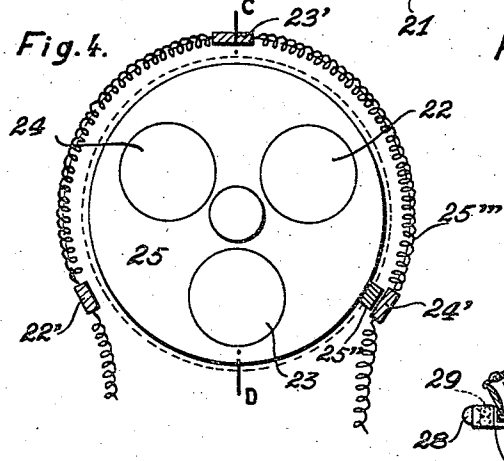


Fig.5.

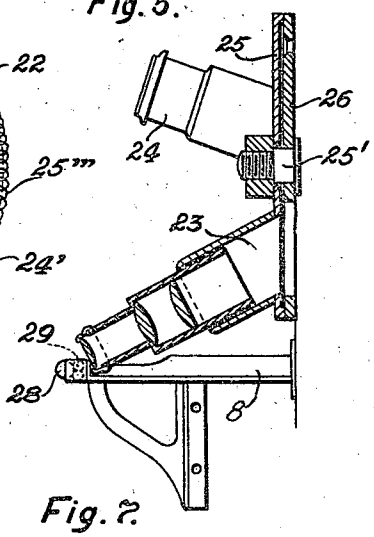


Fig.6.

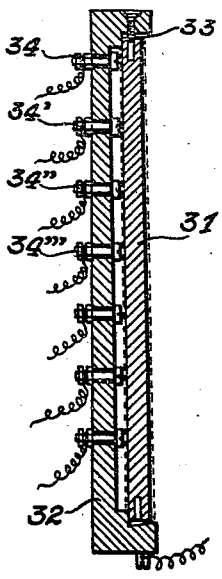
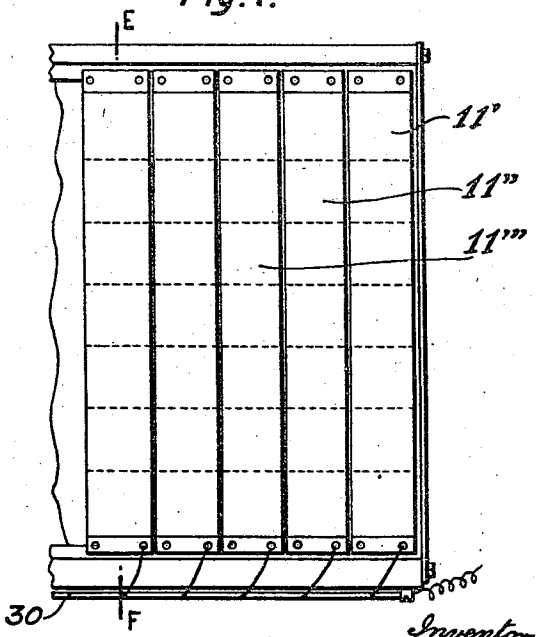


Fig.7.



Inventor
Albert Thomas
by B. Singer
Attorney

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Fig.8.

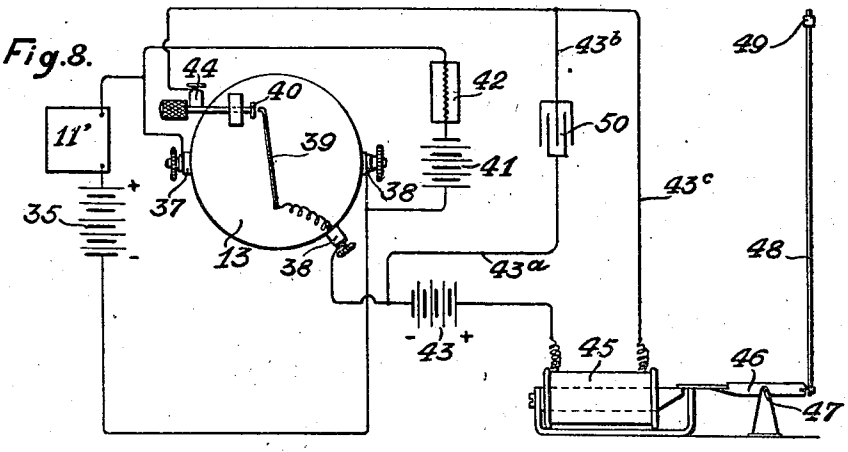


Fig.9.

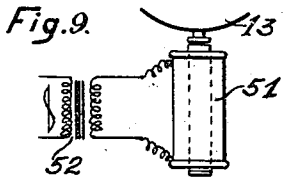


Fig.10.

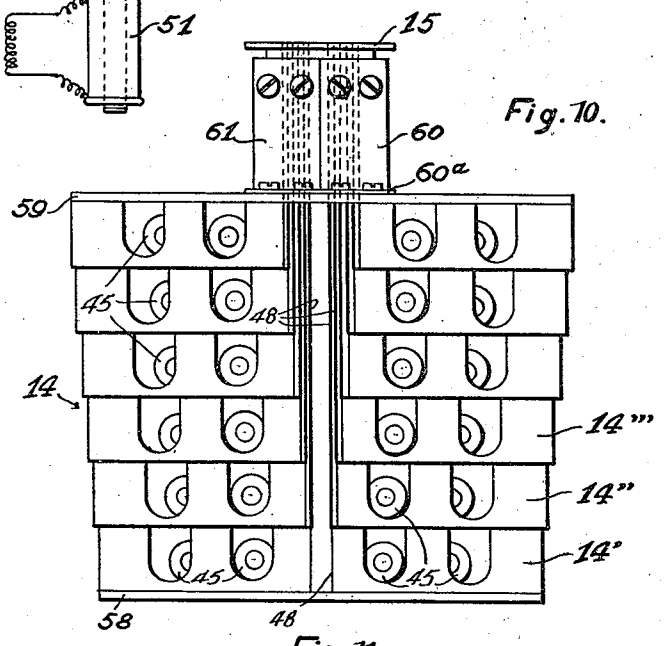
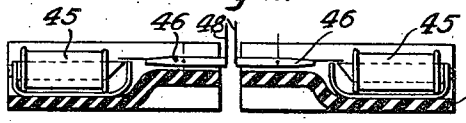


Fig.11.



Inventor
Albert Thomas
by B. Singer
Attorney

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Fig. 12.

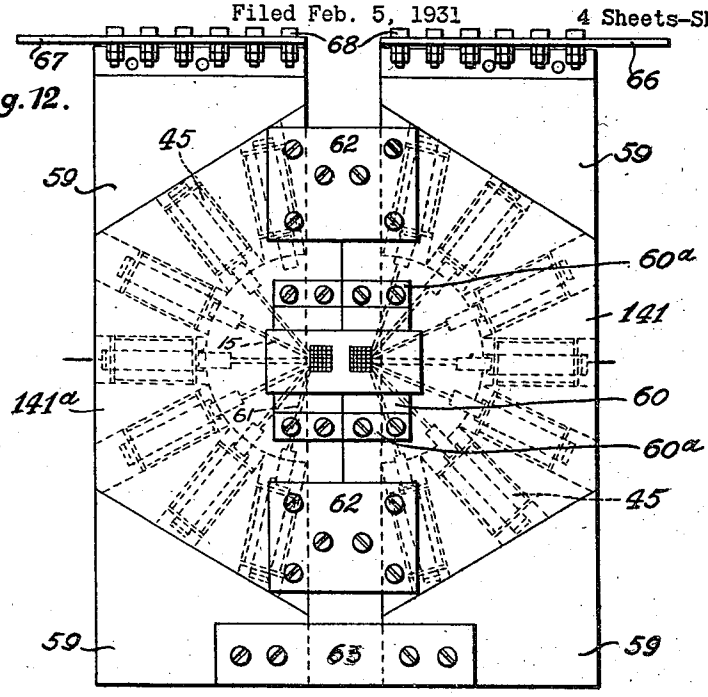


Fig. 16.

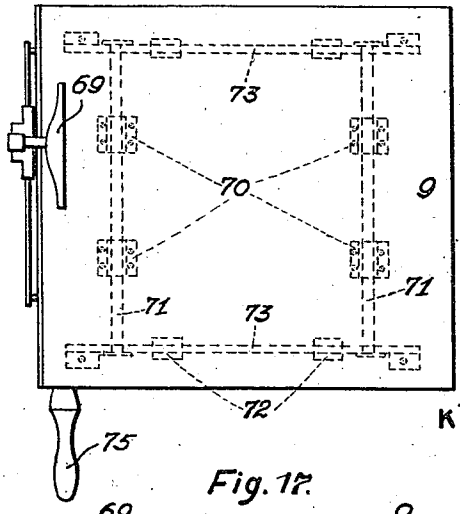
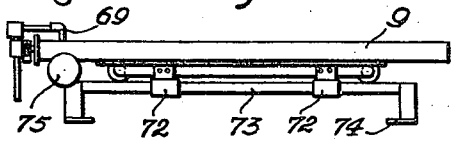


Fig. 17.



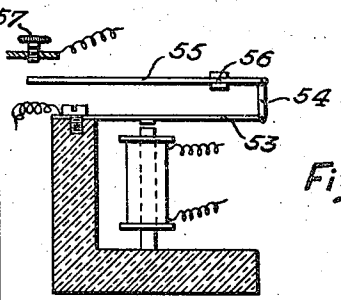


Fig. 13.

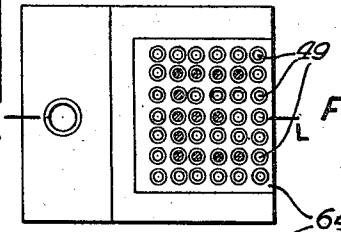


Fig. 14.

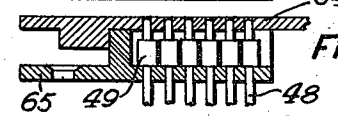


Fig. 15.

Inventor
Albert Thomas
by B. Singer
Attorney

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UNITED STATES PATENT OFFICE

2,035,773

PHOTOELECTRIC APPARATUS

Albert Thomas, Paris, France

Application February 5, 1931, Serial No. 513,764
In France December 8, 1930

8 Claims. (Cl. 250—41.5)

This invention relates to improvements in photo-electric apparatus adapted for use by blind persons to enable them to read printed matter such as newspapers, books and the like and to also read hand written letters, manuscripts and the like by reproducing the same word by word in relief type characters such as blind persons may read by feeling or touching them.

The object of this invention is to provide an improved machine of this type so constructed and arranged that blind persons may readily use and operate the same.

With the above and other objects in view, the invention consists in the construction, combination and arrangement of devices hereinafter described and claimed.

In the accompanying drawings

Figure 1 is a front elevation of photo-electric reading apparatus for the blind constructed and arranged in accordance with this invention.

Figure 2 is a horizontal section of the oscillating camera on the line A—B of Figure 1.

Figure 3 is partly a detail elevation and partly a longitudinal section of the projector.

Figure 4 is a detail plan view of the optical system showing three lenses of different focus.

Figure 5 is a section of the same on the line C—D of Figure 4.

Figure 6 is a detail sectional view, on the line E—F of Figure 7, of a selenium cell carrying element, showing the electrical connections of the cells.

Figure 7 is a detail front elevation of a number of such carrying elements arranged to form the receiving surface for the pictures, types, or characters to be read by transforming the same into relief characters for the touch or feeling of the user at the receiver.

Figure 8 is a diagram of a complete electric circuit for one of the selenium cells.

Figure 9 is a detail diagram of a modification of the same.

Figure 10 is an elevation of the receiving blocks for all of the electro-magnets and the stems or rods operated by the same.

Figure 11 is a detail sectional view of one of the members of said receiving block.

Figure 12 is a plan of the receiving block and of the receiver and guide elements for the feeler rods and indicating the electro-magnets arranged radially in semi-circles.

Figure 13 is a detail elevation partly in section, of a modification including a polarized relay and an amplifying device.

Figure 14 is a detail plan on an enlarged scale of one of the guiding grills and a number of the feeler rods.

Figure 15 is a detail vertical sectional view of the same on the plane indicated by the line K—L of Figure 14.

Figure 16 is a detail plan of the text carrier with parts indicated in dotted lines.

Figure 17 is a detail end elevation of the same.

A piece of furniture 1, such as an office desk with chest and drawers, constitutes the main support of the apparatus. Above the table and on the rear part thereof is placed a rectangular camera 2 which is adapted to be partly turned in either direction in a vertical plane through the medium of two pivots 4 and 4' mounted upon two supports 3 and 3' secured to the table. The usefulness of this oscillating motion will be hereinafter set forth.

On one of the large sides of the camera, towards the front face, are secured a projector 5 and the optical chamber 6 directly communicating with the interior of the camera.

The lower side of the optical chamber 6 is closed by a plate 26 on the lower side of which, on a pivot 25' (Fig. 5) is mounted a revoluble circular plate 25 which carries a plurality of focusing telescopes 22, 23, 24 of different lengths and any one of which when the member 25 is turned by the operator may be focused on the text as may be most appropriate.

The inclination of each of the said focusing telescopes or objectives 22, 23, 24 with respect to the vertical direction must be exactly equal to the inclination of the rays of the source of light with respect to the vertical line. Below the camera a follower arm 8 is arranged which rests lightly on the text to be read, which text is arranged on the manually movable carriage or text carrier 9. The arm 8 is so arranged as to maintain the correct distance in which the axis of the illuminating device and the objective intersect. Said follower arm operates to maintain the camera at the distance from the text corresponding to the exact focal distance at which the axis of the projector 5 and of the objective lens or focusing telescope meet, in the correct position for reading.

No text is specially prepared. On the contrary any ordinary text may be read, such as that of a single sheet of paper, a periodical, or a book or the like. If the text is that of a periodical, book, catalog, or the like, it may not be exactly flat on the carrier. It is for this particular case of deformation of the sheet carrying the text, because of the binding, that makes it necessary to

enable the chamber or camera to follow irregularities in the sheet of the text so as to preserve the focal distance of the objective under all conditions of the text. The follower arm 8 rises or descends on the text if the latter is deformed or departs from a true horizontal plane, as will be understood.

The individual objectives differ externally in form, all within the scope of my invention, and are otherwise so constructed or provided as to enable them to be readily distinguished each from the others by touch.

The ability of the camera to describe rocking movement permits the follower arm 8 to follow and conform to all the level variations of the text when the book, newspaper or the like to be read, which is in open position, rests upon the carriage 9.

The pivot pins 4, 4' are so disposed that the camera will be correctly balanced, requiring but a very slight pressure to keep the arm 8 pressed lightly upon the text to be read. The direction of the light ray is indicated in dotted lines in Figures 1 and 2. The said ray, emitted from the projector 5, strikes the text to be read in the vicinity of the arm 8, is reflected parallel to the axis of the focused objective or telescopes 22, 23, or 24, crosses the same and strikes the plane inclined mirror 10 which reflects the light ray or beam upon the following plane mirrors 10', 10'', 10''', the angles of incidence of which are so adjusted as to direct the light ray upon a field of photo-electric cells 11, the number of which may vary according to the readings which are to be effected and in practice is usually about forty-two. These photo-electric cells 11', 11'', 11''' are such as to receive a light or dark ray controlling the passage of the electric current operating the relays which in turn operate feeler rods 48 projecting from the receiver 15.

The photo-electric cells are arranged in close relation to one another and so as to form a block which extends entirely across the end of the disc chamber of the camera opposite the mirror 10''' and are all in the same plane so that the surface of each of them is exposed to any ray of light which reaches the interior of the camera from the projector 5, as will be understood, and as clearly indicated at 11 in Figures 1 and 2 and also at 11', 11'', 11''' in Figure 7.

The current of the cells 11, 11', 11'', the so called primary current, is led from each cell through an insulated conductor wire, as indicated in Figure 7 and also diagrammatically in Figure 8, all of which wires constitute the bundle 12 indicated in Figure 1 from the camera 2 to the table 1 where they are respectively branched to as many very sensitive relays 13, 13', 13'' and so on, as will be understood. The relays receiving the current from the non-lighted cells constitute a contact which allows the secondary current, more powerful than the first one, to pass into the electro-magnets 45 which are arranged radially in the respective cells or sections 14', 14'', 14''' and so on of the block 14 (Fig. 1) which is here shown as secured under the table top and which electro-magnets actuate the feeler rods 48 of the keys appearing in relief under the finger of the operator at the receiver 15.

The apparatus is arranged so that the upper ends of the rods 48 are all disposed in the same plane when all the magnets 45 are energized, but if any of the magnets 45 are deenergized, the corresponding rods 48 drop downwardly so that their upper ends are disposed below the level of the upper ends of the rods whose magnets are energized.

In operation, when printed or other matter is placed in front of the objective 20 and suitably illuminated by means of the lamp 16, the image thrown on the mirror 10''' illuminates certain of the selenium cells 11 so that these become more conductive and cause the corresponding relays 13, 13', 13'' to be energized with the result that the corresponding electro-magnets 45 are deenergized and certain of the rods 48 move downwardly. The relays 13, 13', 13'', connected to those selenium cells which are covered by the image of the letter or letters disposed in front of the objective are not energized, with the result that the rods 48 corresponding to these cells do not move and a reproduction in relief of the letter or letters is thus produced by the projecting ends of those rods 48 which do not move. The user can thus read the letters placed in front of the objective by feeling the ends of the rods 48.

The projector 5 is here shown in Figure 3 as comprising a casing 21 having a spherical glow lamp 16 in one end, the filament of which is so disposed as to direct a luminous flash to the focus of a parabola 17 of polished metal which directs the luminous rays upon a condensing lens 18 and which lens converges said rays into a cooling water tank 19 and to another condensing lens 20, the focus of which is such as to produce a luminous flash on the text to be read. The lenses of the telescopes 22, 23 and 24 are of such different focus as to allow of adjustment to the field covered by the characters of the text to be read and which may be of different sizes and to thereby enable such text characters, from the smallest to the largest, to be readily read, by causing them to appear at the receiver grid 64 as all of the same size, by the touch of the operator.

Should it be desired to increase to a larger extent the projections at such field, it is possible to increase the number of the telescopes, as will be understood. A spring stop is in practice employed to automatically determine the exact position of each telescope which is focused to be read, relatively to the projector.

Means is provided for the adjustment of the light projected upon the said field. The light, depending upon the luminosity of the telescope, the adjustment of the photo-electric cells and relays will be effected with the less luminous telescope and for the purpose of returning the same telescope to the same clearance on the field, I employ, as here shown in Figure 4, a resistance in the form of a helically coiled wire 25 calibrated to correspond to the respective telescopes and provided with contact members 22', 23' and 24'. A brush 25'' carried by and movable with the member 25 by contact with the appropriate contact member thus controls the intensity of the lighting current supplying the lamp 16 of the projector and automatically switching in the greatest resistance for the most luminous telescope. The lower end of the focusing glass permits sight of a steel ball 28 which bears on the text to be read. Said ball rolls over a fixed stop which is constituted by several small balls 29. The balls are held in a suitable socket provided at the lower end of the arm 8 which extends downwardly from the camera. Because of the relatively small scale of Figure 1, member 28 is not shown in said figure, but is shown in detail in Figure 5, in which for the purpose of

clearness members 25, 26 are shown vertically arranged and member 8 horizontally arranged.

The photo-electric cells 11', 1'', 1''' and so on are illustrated in Figures 6 and 7 as being arranged in a single plane and are all connected to the common lead 30, for returning the primary current. 31 indicates a stick or assembly of photo-electric cells, the sticks or sections being arranged in a molded insulating member 32 and being secured therein by means of screws 33 so that they can be readily removed. These sections or sticks are insulated each from the others and disposed as indicated in Figure 7. The windings of the sticks are constituted by parallel leads or wires, which may be gold plated, or made of gold to avoid oxidation during the treatment of the selenium. Each stick or section is divided into a number of parts each of which constitutes a selenium cell. Binding posts 34, 34' and the like permit the making up of the intermediate connections for each cell, whose leads constitute at the point where they emerge from the camera the bundle 12 indicated in Figure 1. As to these intermediate connections, it should be observed that the first lead or wire being a common pole for all of the cells of a stick or section, is branched upon the conductor 30 (Figure 7). The breaks between the cells are effected upon the second wire in order to connect them respectively with the terminals 34, 34' and so on.

The explanation of the circuits of the primary and secondary currents of Figure 8 is as follows:

Each of the cells 11' which represents one of the members of the field of cells (Figure 7) continually receives current from the battery or other source 35. The primary current from the battery is received by a terminal 34, as indicated in Figure 6, and is led by an insulated conductor to one of the terminals 37 of a relay 13 and passes through the coil of the movable member thereof back through the terminal 38 to its source 35. It is the amplification of the current from the source 35 determined by the conductivity of the selenium of the lighted cell 11' which causes the contact pointer 39 to be shifted to the right and held in such position (Figure 8).

A balancing circuit is connected to the terminals 37 and 38 of the relay 13 to correct the too-high conductivity of the selenium which causes the deflection towards the right, as far as the point at which the contact pointer or needle 39 is locked by means of the bottom current of the cell 11' in the darkness.

The current of this balancing circuit which is passing through the coil or winding of the relay in a direction reverse to the preceding one is supplied from a battery or other source of electricity 41 and is exactly adjusted in accordance with the standard resistance 42 so as to return the contact pointer 39 to its starting point, the cell 11' being in the darkness so as to allow the relay 13 to operate but with current amplified by the cell in the lighting stage.

The secondary current is supplied by a battery or other source 43 and passes through to shunt conductors 43^a, 43^b and condenser 50 to the insulated terminal 44 of an adjustable contact 40, made of non-oxydizable metal.

When the cell 11' is in darkness, the contact pointer or needle 39 bears against the contact 40 and hence the secondary current passes, through the medium of the needle 39 and the terminal 38' of the relay 13 and shunt conductor 43^c, into an electromagnet 45 which then draws a balanced horizontal paddle 46 pivoting at 47 and which causes the rise of one of the thin and light feeler rods 48. Each said rod is provided near its upper end with a spacing and stop button 49 (Figure 13), which may be screwed thereon so that the upper end of the feeler rod appears in relief at the receiver 15 of the table, and is adapted to be touched by the finger of the user.

When the cell 11' is lighted, the contact pointer 39 leaves the contact 40 and as the secondary current is no longer passing through the electro-magnet 45, the rod 48 falls back to its position of rest, the button 49, by engaging the member 65 serving to limit the downward movement of the rod.

It should be observed that for the purpose of avoiding sticking of the contacts 39, 40 of the secondary current at the moment the primary current is increased, it is necessary to connect the condenser 50 in the shunt between the terminal 38' and the terminal 44.

Another means for preventing such sticking consists in disposing for instance a suitable number of vibrators 51 receiving the current from an alternating transformer 52 upon the plate supporting the relays (Figure 9).

Figure 13 shows a relay, with an amplifying device which can be used. A leaf spring 53 which is insulated at its fixed end, actuates when the current of the cell is passing through the relay coil a link 54 which is connected with a lever 55 pivoted at 56. The said lever 55 is adapted to engage an adjustable contact 57 and thereby closes a secondary circuit, whose current controls the feeler rods 48.

As regards the receiving members, Figure 10 shows the unit or block 14 containing the electro-magnets 45. Said block consists of members 14' made of insulating material and arranged in a plurality of superposed sections or members as at 14', 14'', 14''' (Figure 10), the said blocks in each member being radially arranged so that a vertical central opening is formed between their opposing inner ends for the reception of the rods 48. There can be any required number, which is determined by the use for which the machine is intended. In order to facilitate the mounting or setting up, the unit 14 is constituted by two right and left members 141, 141^a (Figure 12) connected by lower metal plates 58 and upper metal plates 59 with connecting plates 62 and 63. The upper portion of the unit 14 is terminated by a guide for the rods 48, consisting of two parts 60 and 61 connected together by screws and plates 60^a, and finally terminated by a grid 64 forming the receiver 15 which is located in the top of the table 1.

Figure 11 shows in section electro-magnets 45, one of which appears in Figure 8, in recesses provided for this purpose in the members 14' in section. At the end of the paddles 46, one can see the start of the rods 48.

Figure 12 indicates, in dotted lines, the location of each electro-magnet 45 in the upper member of the block 14, which permit free access to the rods 48 at the place which is indicated on the receiver 15. The lower part 65 forms, together with member 64, a box and acts as a guide for the rods 48.

In Figure 12, 66 and 67 are two fiber plates secured to the lower plate 58. Through the said plates pass small brass binders 68 to which the leads or wires of the electro-magnets are respectively connected.

The carriage of the machine (Figure 16) is essentially constituted by a table 9 on which are

arranged one or two claw springs 69 used for securing on the said table the document, newspaper, book or the like to be read.

Four slides 70 secured under the said table slide over two profile irons 71 of suitable section. To these two profile iron parts a translating motion is imparted in the perpendicular direction by means of slides 72 which also slide over two profile parts 73. The carriage is secured to the table by means of four lugs 74. The movement of the cariage is facilitated by a handle 75 to be grasped by the operator, and which can in turn control a screw (not shown) with fast or rapid thread for facilitating the movement.

The operation is as follows, assuming the machine as being connected to a source of electric power for lighting purposes, the text to be read being first placed on the carriage 9.

The blind person who is to read the text tries the object glasses and ascertains the focusing on the field of the cells 11 by feeling or touching the receiver 15. Should the types or characters of the text which is to be read appear as a whole on the receiver 15, as points in relief which are formed by points of the rods 48, such for instance as the letter E (black points Figure 14) and of which the blind person by touch mentally perceives, the machine is adjusted and the reading can be effected. In pushing the carriage 9 to the one or the other side, the types or characters are projected in the camera in regular sequence one after another and transmitted also one after another in relief to the receiver 15 for the touch of the blind person.

Each type formed in relief will vanish from the receiver as soon as the character changes under the object glass. It is thereby possible to obtain a sequence of moving types or characters just as in some of the luminous advertising displays. The blind person mentally perceives the said sequence in a similar manner as done by the eye as regards the above mentioned luminous advertising displays.

With certain characters or types which do not give in relief the exact relief, the said outline is equally mentally perceived as easily as the eye clears up an incomplete word in a sentence.

The transmission of the characters being effected at the receiver through the medium of the enlarged picture of the said character in the field of the cells, it will be understood that manuscripts in all languages, of any form, small figures, drawings, and the like, can be perceived by the blind person as easily as in the case of typed matter.

When it is a question of a text to be read, in a book for instance, which does not show a perfectly smooth surface, it is then that the stay or prop 8 and the oscillation of the camera intervene and are effective to secure the focal distance which is required for the projection of the one or the other of the object glasses, as will be understood.

What I claim is:—

1. In combination, a carrier for the text to be read, a dark chamber mounted for oscillating movement and having a photo-electric element therein, and a projector on said chamber having means to project an image of text on said element and also having a follower arm, said arm being adapted to bear and move on the text to be read and arranged for following the various levels of this text and to maintain the focal distance constant.

2. A photo-electric machine for the blind, comprising a manually movable carriage for the text, a dark chamber mounted for oscillating movement in a vertical plane, said chamber having a photo-electric element disposed in the interior thereof, a follower arm projecting from said chamber and arranged to bear on the text, a projector on the dark chamber, an optical system having a plurality of lenses for regulating the projection of characters to be admitted in their entirety to the receiver, an electric circuit influencing electro-magnets and means for arranging and holding these electro-magnets in a unitary receiving block.

3. In apparatus of the class described, radially arranged electro magnets, means for holding said electro magnets, vertically arranged rods each movable vertically by one of the electro magnets, said rods being arranged in a group located in the center space from which the electro magnets radiate and the upper ends thereof constituting relief points to be touched by the operator, and a grill by which said rods are guided spaced apart and so arranged as to dispose their upper ends in a common field adapting all of them to be touched by the finger of the operator.

4. Photo-electric apparatus for the blind, comprising a carrier for texts, said carrier being adapted to be moved manually by the user, a receiving grid, a plurality of feeler rods grouped and movable in the grid, a dark chamber mounted for lateral oscillating movement in a vertical plane and having a follower arm to bear on the text on said carrier, a photo-electric element in said chamber, means including a projector on the chamber to project an image of the text onto said photo-electric element and operating means for the feeler rods controlled by said photo-electric element.

5. Apparatus as claimed in claim 4, in which the projector is provided with a plurality of focusing telescopes of different lengths and means by which said telescopes are attached to the chamber, said attaching means being movable on the chamber to enable any one of the telescopes to be focused on the text.

6. Apparatus as claimed in claim 4, in which the photo-electric element comprises a plurality of members one for each of the feeler rods and in which the operating means for the feeler rods includes a plurality of electro-magnets, one for each feeler rod and means for supporting said electro-magnets in a group arranged radially with respect to the group of feeler rods.

7. Apparatus as claimed in claim 4, in which the photo-electric element comprises a plurality of members one for each of the feeler rods and in which the operating means for the feeler rods includes a plurality of electro-magnets, one for each feeler rod, and means for supporting said electro-magnets in a group arranged radially with respect to the group of feeler rods, said means being a block having cells for the reception of the electro-magnets and said group of feeler rods being arranged in the center of said block.

8. Apparatus as claimed in claim 4, in which the projector is provided with a plurality of objectives each differing from the others in such respect as to enable the individual objectives to be readily distinguished by touch.

ALBERT THOMAS.