R. L. WATKINS.

PHOTOMICROGRAPHIC CAMERA.

APPLICATION FILED MAY 16, 1907.

1,161,556. Patented Nov. 23, 1915.

6 SHEETS—SHEET 1.

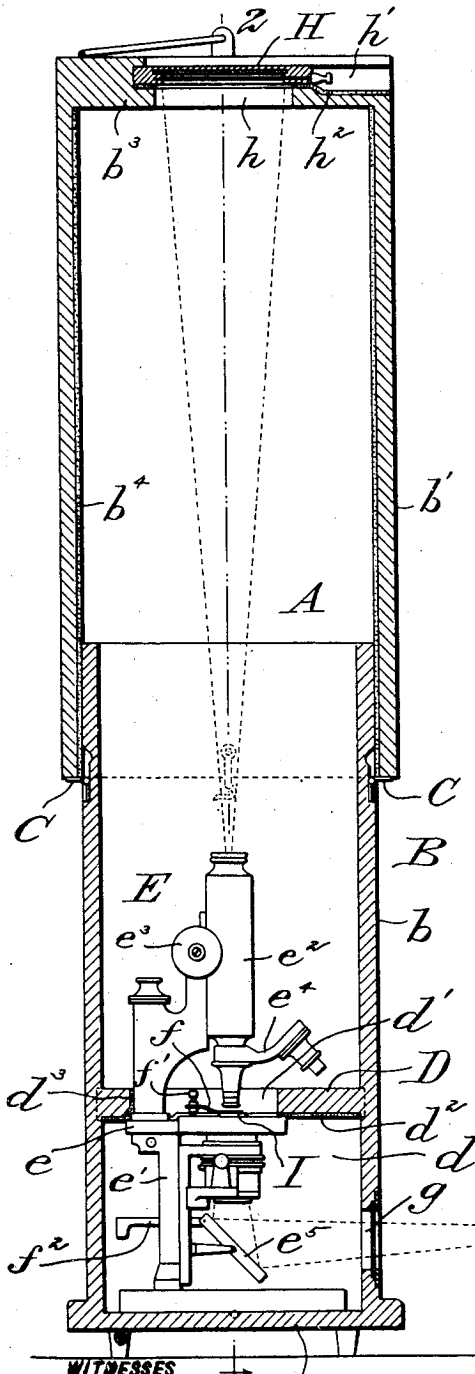


Fig. 1.

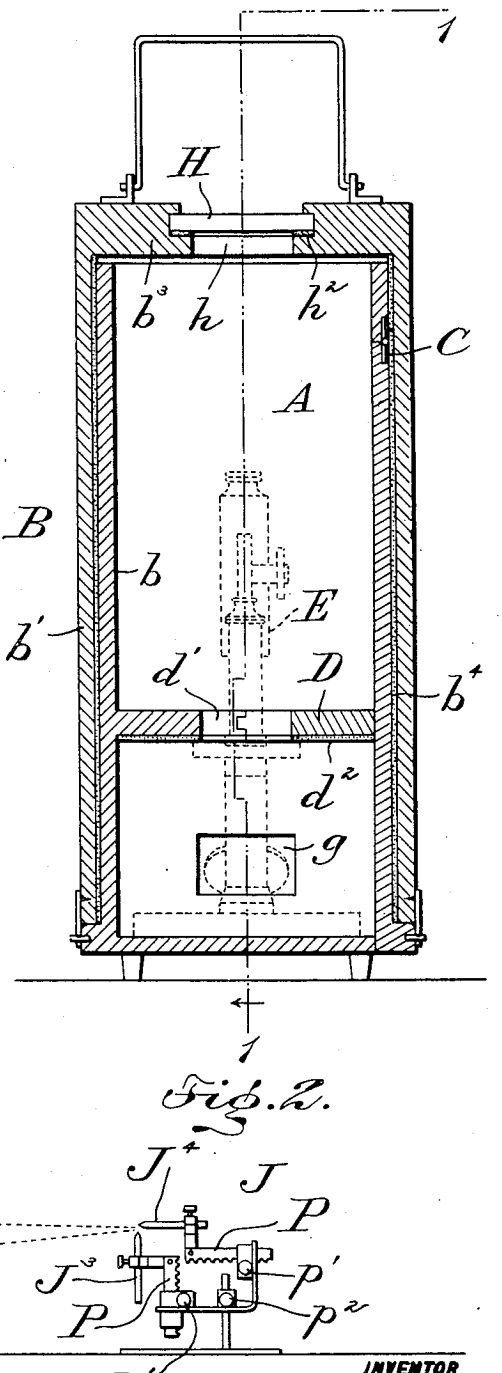


Fig. 2.

WITNESSES

H. C. Talbott

V. E. Nichols

INVENTOR

Robert L. Watkins

BY Griffin & Brinkerhoff

ATTORNEYS

R. L. WATKINS.

PHOTOMICROGRAPHIC CAMERA.

APPLICATION FILED MAY 16, 1907.

1,161,556. Patented Nov. 23, 1915.

6 SHEETS—SHEET 2.

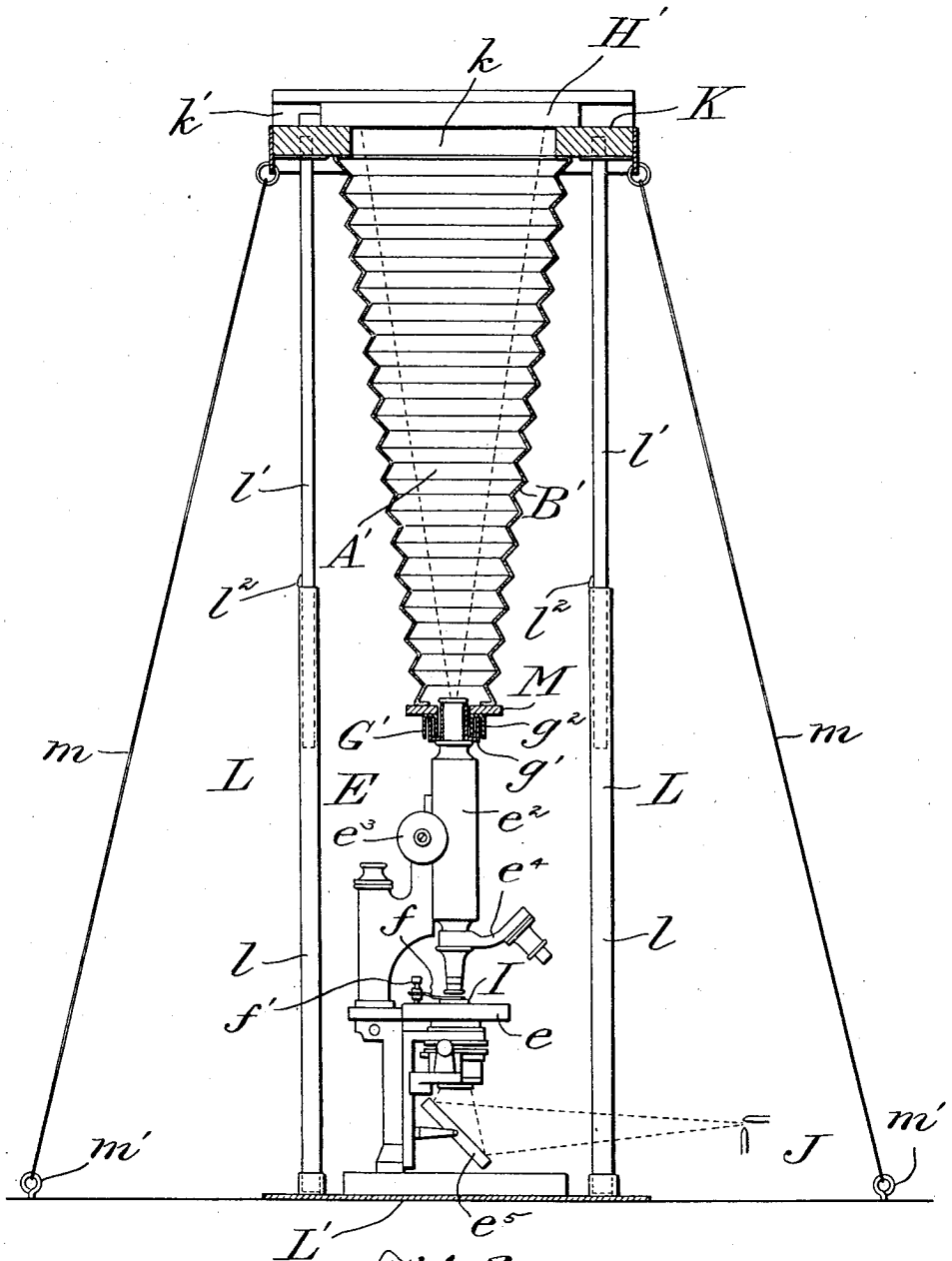


Fig. 3.

WITNESSES

A. C. Abbott

V. E. Nichols

INVENTOR

Robert L. Watkins

BY Griffin & Bernhard

ATTORNEYS

R. L. WATKINS.

PHOTOMICROGRAPHIC CAMERA.

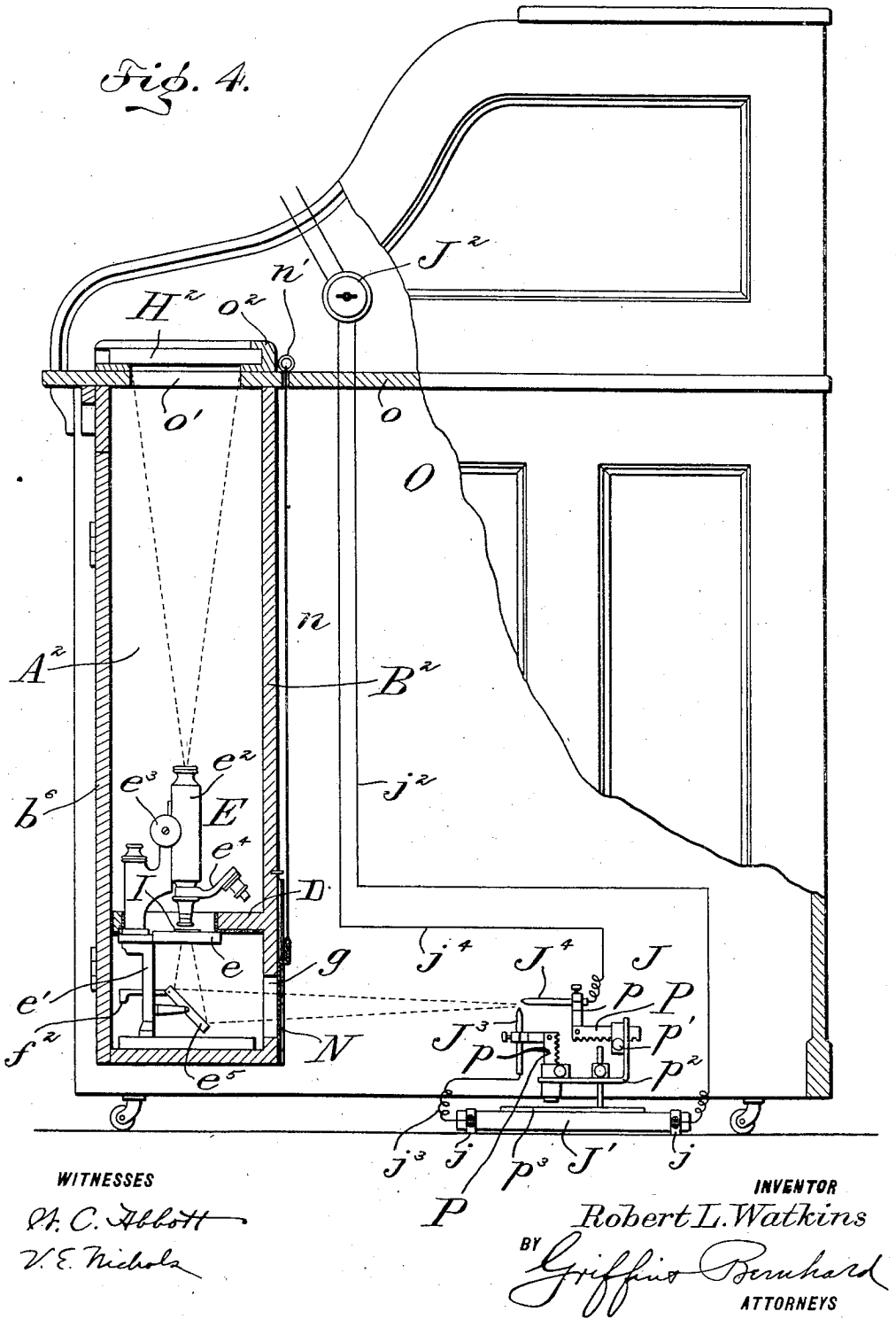
APPLICATION FILED MAY 16, 1907.

1,161,556.

Patented Nov. 23, 1915.

6 SHEETS—SHEET 3.

Fig. 4.



WITNESSES

A. C. Abbott

V. E. Nichols

INVENTOR

Robert L. Watkins

BY Griffin & Bernhard

ATTORNEYS

R. L. WATKINS.

PHOTOMICROGRAPHIC CAMERA.

APPLICATION FILED MAY 16, 1907.

1,161,556.

Patented Nov. 23, 1915.

6 SHEETS—SHEET 4.

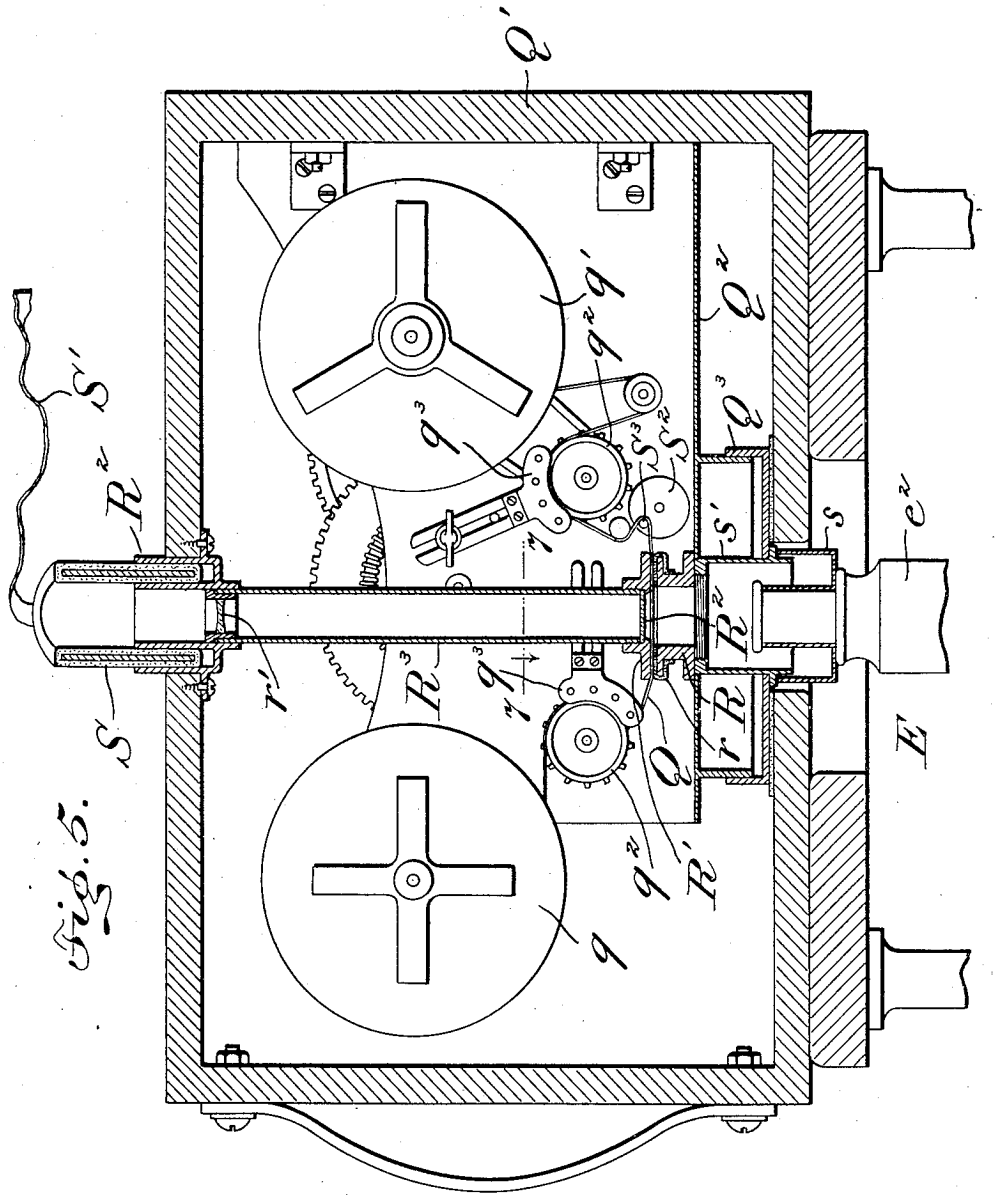


Fig. 5.

WITNESSES

M. C. Abbott

V. E. Nichols

INVENTOR

Robert L. Watkins

BY Griffin & Brubaker

ATTORNEYS

R. L. WATKINS.

PHOTOMICROGRAPHIC CAMERA.

APPLICATION FILED MAY 16, 1907.

1,161,556.

Patented Nov. 23, 1915.

6 SHEETS—SHEET 5.

Fig. 6.

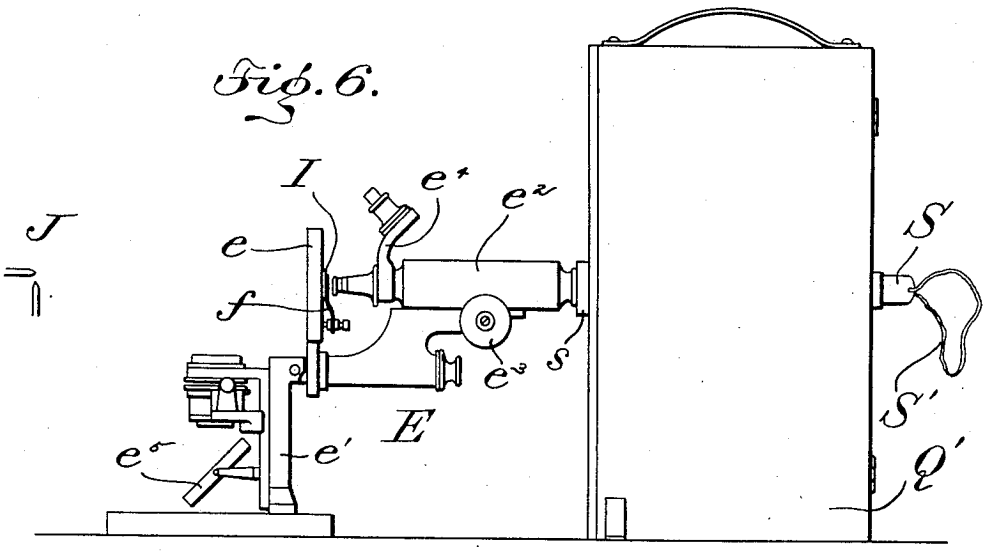


Fig. 7.

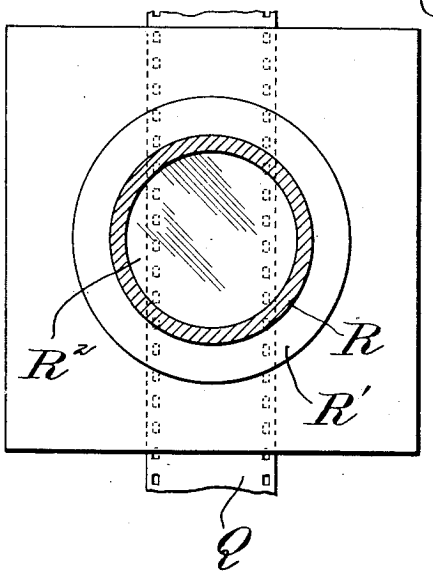
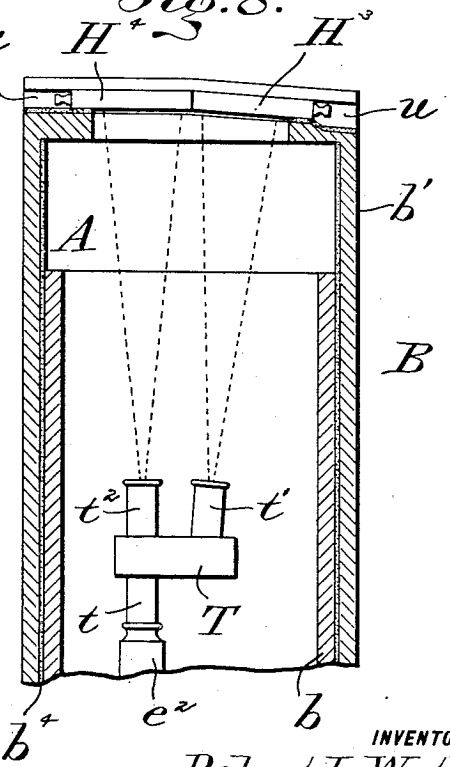


Fig. 8.



WITNESSES

H. C. Abbott

V. E. Nichols

INVENTOR

Robert L. Watkins

BY Griffin & Brinkard

ATTORNEYS

R. L. WATKINS.

PHOTOMICROGRAPHIC CAMERA.

APPLICATION FILED MAY 16, 1907.

1,161,556.

Patented Nov. 23, 1915.

6 SHEETS—SHEET 6.

Fig. 9.

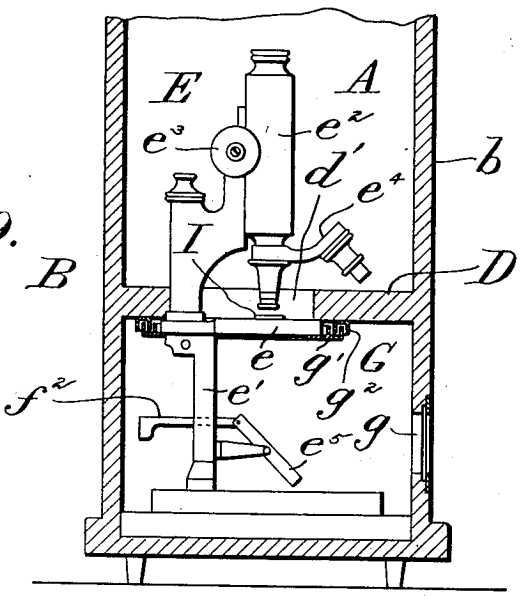


Fig. 12.

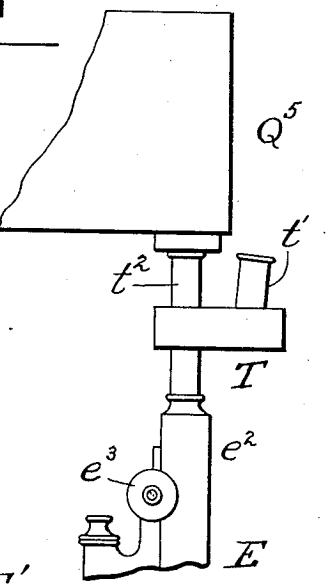


Fig. 10.

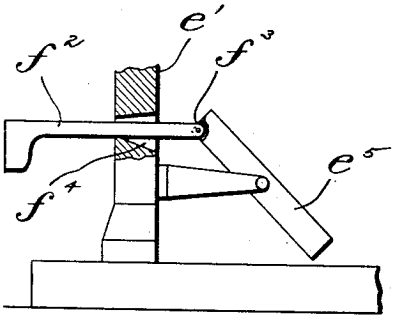
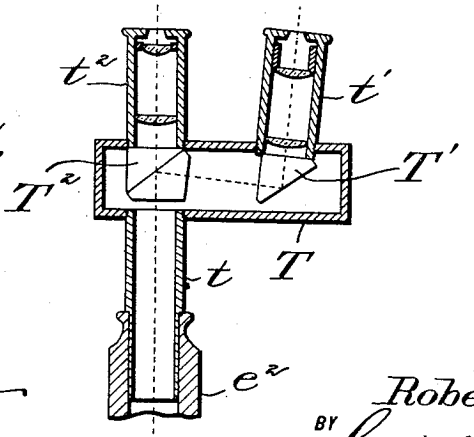


Fig. 11.



WITNESSES

H. C. Abbott

V. E. Nichols

INVENTOR

Robert L. Watkins

BY Griffin & Bernhard

ATTORNEYS

UNITED STATES PATENT OFFICE.

ROBERT L. WATKINS, OF NEW YORK, N. Y.

PHOTOMICROGRAPHIC CAMERA.

1,161,556. Specification of Letters Patent. Patented Nov. 23, 1915.

Application filed May 16, 1907. Serial No. 373,985.

To all whom it may concern:

Be it known that I, ROBERT L. WATKINS, a citizen of the United States of America, residing at the city of New York, borough of Manhattan, in the State of New York, have invented a certain new and useful Photomicrographic Camera, of which the following is a specification.

The object of the invention is to photograph objects which have been magnified by means of a microscope.

In recent years great progress has been made in diagnosing various diseases and ailments by a microscopical examination of the blood, it appearing that each distinct disease of the system is manifested by certain physiological characteristics in the blood.

So far as I am aware, however, no successful or efficient apparatus has been devised for quickly photographing the particular thing being examined, such as the blood, while the same is in a magnified state, in order to produce a permanent photographic record thereof.

The invention herein under consideration has proven in practice to be of great assistance, and, in fact, almost indispensable to a rapid and accurate examination of the blood and the production of an enlarged photographic record of the same. The great advantage of such records will be manifest, since a series of photographs taken during successive periods, will indicate the progress or condition of the particular ailment with which the subject may be afflicted.

In a specific sense, I have illustrated and described several forms or embodiments of the invention, one being adapted particularly for office use, whereas another is a portable type which adapts it for use by the physician when making his usual visits to the patient. Furthermore, I have devised means whereby I am enabled to produce a succession of photographs on a continuous film, such film being adapted for use in the so called "moving picture machines", thereby portraying various physiological operations, such as the movement of the corpuscles of the blood. This particular embodiment of the invention adapts it for use in giving lectures or instruction to medical students.

Figure 1 is a vertical section of one type of portable photomicrographic camera adjusted in position for use, and constructed in accordance with this invention, the plane of the section being indicated by the dotted line 1—1 of Fig. 2 looking in the direction of the arrow. Fig. 2 is a vertical section in a plane at right angles to Fig. 1 and on the dotted line 2—2 of said figure, showing the portable apparatus collasped or folded for convenient transportation. Fig. 3 is a vertical section, partly in elevation, illustrating another embodiment of a portable camera adjusted in position for use in connection with a microscope and other parts of the apparatus as contemplated by this invention. Fig. 4 is a vertical section, partly in elevation, showing a cabinet constructed in accordance with this invention, and adapted especially for office use. Fig. 5 is a vertical section, partly in elevation, illustrating my invention adapted for use in connection with a so called "moving picture machine" whereby a succession of pictures may be produced on a continuous film. Fig. 6 is an elevation showing the apparatus of Fig. 5 adjusted for use in another position for the purpose of omitting the reflector of the microscope, whereby the rays of light may be directed through the sight tube of said microscope. Fig. 7 is a detail cross section on an enlarged scale, and in the plane of the dotted line 7—7 of Fig. 5, illustrating one means employed by me for focusing an image projected on a ground glass by the microscope. Fig. 8 is a vertical section of a part of the portable apparatus shown in Figs. 1 and 2, representing a binocular adapted for use in connection with a microscope so as to project two images onto separate light sensitive surfaces adapted to be held by independent plate holders in the path of said binocular. Fig. 9 is a detail view showing another embodiment of means for securing a light-tight joint between a microscope and a transverse partition forming a part of the portable apparatus shown in Figs. 1 and 2. Fig. 10 is a detail view showing one means for conveniently adjusting the mirror of the microscope. Fig. 11 is a detail vertical section through the binocular of Fig. 8 and which is adapted for use in connection with the various types of apparatus shown by the drawings. Fig. 12 is a view in side elevation showing one method of using a

binocular in connection with a microscope and a continuous film camera, the object being to view the subject through the microscope and focus the latter while making the photographic exposures on the sensitized film.

The type of portable apparatus shown in Figs. 1 and 2 of the drawings contemplates the employment of an extensible light-tight compartment, A, herein shown as provided by a telescoping light tight casing, B. Said casing consists of the telescoping sections, b, b', the lower section, b, being closed at its lower part by a head, b^2, and open at its upper part, whereas the upper section, b', is open at its lower part and provided at its upper part with a head, b^3. The inner surfaces of the sections, b, b', are coated with a suitable black material, such as is commonly employed in photographic cameras, and it is preferred, furthermore, to line the sliding upper section, b', with felt or other material, as indicated at b^4. When the section, b', is raised to the position shown in Fig. 1, for the purpose of bringing the apparatus into use, said section may be locked in said raised position by any suitable form of detent, the same being shown as automatic locking devices C which are adapted to take beneath the section, b', when it is raised.

The extensible light-tight chamber, A, is divided near its lower part by a horizontal partition, D, which is secured in the lower section, b, of the casing, B, thereby forming a sub-chamber, d, below said partition. This sub-chamber is adapted for the reception of a part of a magnifying apparatus herein shown as a microscope, E, the same being of any usual or preferred construction. Said microscope is represented as consisting of a table, e, which is supported on a base or stand, e', a lens tube, e^2, a screw adjustment, e^3, for focusing said lens tube, a lens holder, e^4, adapted to be adjusted for the purpose of bringing any one of a plurality of lenses into alinement with the lens tube, e^2, and a mirror, e^5, which is mounted below the table, e, and is adjustable to different positions in order that it may reflect the rays of light through the lens tube.

In addition to the parts herein mentioned, the microscope is provided with means for holding the object or subject under examination firmly in position on the table e, and as shown, said subject-holding means consists of springs, f, adapted to be clamped on the table by screws, f'. Furthermore, the microscope is at times placed in such a position that the mirror cannot be operated conveniently. To overcome this objection I contemplate the employment of an operating member or piece, f^2, which is pivotally connected as at f^3 to an edge portion of the pivoted mirror, e^5, see Fig. 10. This operating piece is shown as extending through an opening, f^4, which is provided in the base or stand of the microscope, whereby the part f^2 is held in place so that it may be easily reached when it is desired to adjust the mirror. Said operating piece f^2 may, however, be of any suitable length in order to extend either outside of the chamber d in the apparatus or in a convenient position therein, whereby the mirror may be adjusted with facility.

In the lower part of the casing section, b, is an opening, g, for the admission of light into the compartment, d, and this opening may or may not be closed by a shutter, as desired. The magnifying apparatus, E, is adapted to be introduced into the section, b, in any suitable way, and said apparatus is adapted to partly extend through an opening, d', which is provided in the partition, D. The lower part of said microscope occupies the chamber, d, so that the table, e, of said microscope will engage with the underside of the partition, D. It is important to exclude the light, admitted to the chamber, d, from the chamber, A, and this result may be accomplished in a number of ways. In Figs. 1 and 2 the partition, D, is shown as having a lining, d^2, on its under surface, said lining having a lip, d^3, extending into one edge of the opening, d'. The table, e, of the microscope is adapted to fit firmly against the underside of the partition, D, so as to make a tight joint with the lining, d^2, and the lid, d^3, thereof, the lower part of the microscope occupying the chamber, d, and the upper part of the microscope extending into the lower part of the chamber, A.

In Fig. 9, however, I have shown a light-tight coupling adapted to coöperate with the partition, D, and the table, e, of the microscope. This coupling, G, consists of a member, g', adapted to the table, e, and another member, g^2, adapted to the underside of the partition, D. The member, g', may be fitted on or connected to the table, e, in any suitable way, and said member is provided on its upper side with concentric flanges adapted to form an intermediate channel or groove. The member, g^2, of the coupling may be fastened to the partition, D, in any suitable way, and on the underside of said member, g^2, are concentric flanges forming an intermediate channel. The two members are adapted for the flanges of one member to fit into the channel of the other member, thereby producing a double interlocking arrangement which effectually prevents the passage of light, and as the members of the coupling, G, extend around the opening, d', in the partition, D, the rays of light are thoroughly excluded from the chamber, A.

The upper member, b', of the extensible casing, B, is provided in the head, b, with an opening, h, and the head, b^3, is provided, furthermore, with a recess, h', adapted to

receive means such as a plate holder H, for supporting a photographic sensitive surface in the path of an enlarged image which is projected by the microscope onto said surface. Said plate holder, H, may be of the usual or any preferred construction, and as shown, it is adapted to enter the recess h', in a position to cover the opening, h, a light-tight joint being secured between the said plate holder and the head, b^3, by a lining, h^2, of an appropriate material. It will be understood that the plate holder is equipped with means for receiving a sensitized plate, and with a slide which may be withdrawn after the holder is placed in position in order to expose the plate directly over the opening, h, of the casing, B.

The operation of the apparatus as thus far described is as follows: One or more drops of blood, to be subjected to microscopic examination, is taken from the patient and deposited on a piece of glass, or other transparent material, indicated at I in Fig. 1, and this transparent piece is placed on the table, e, of the microscope so as to be held in position by the springs, f. The proper lens is applied to the holder, e^4 and the microscope is adjusted so as to focus the lens relative to the subject. The microscope is placed in position in the section, b, of the casing, and the mirror, e^5, is adjusted so as to reflect the rays of light from a suitable source of light, such as the electric arc lamp, J, the rays being thrown from the lamp through the opening, g, of the casing onto the mirror, e^5. Before starting the lamp into service, however, the section, b', of the casing is raised and the catches, C, are adjusted to lock said casing in said raised position. The plate holder, H, containing the sensitized plate, is placed on top of the head, b^3, and the slide of said plate holder is then withdrawn, thus leaving the plate exposed over the opening, h'. When the parts have been properly adjusted an electric current is admitted to the lamp, J, and the rays of light from the arc are projected onto the mirror, e^5, the latter reflecting the light rays through the microscope. The microscope operates to project an enlarged image of the subject contained on the plate, I, onto the sensitized surface of the plate in the holder, H, and the proper exposure having been made, the switch is operated to cut the lamp, J, out of service, after which the slide is replaced in the plate holder and the latter is removed from the casing, B, in order that the exposed plate may be developed and fixed in the usual way.

It is evident that the section, b', of the casing may be lowered upon the section, b, in order to reduce the height of the apparatus, and as the arc lamp, J, is of compact construction, the entire apparatus may be folded and packed within a small space for convenience in storage and transportation.

The apparatus shown in Fig. 3 of the drawings is quite similar in its general construction to that described in Figs. 1 and 2. The microscope, E, is of the same construction, and in connection with said microscope the arc lamp, J, is employed. Instead of inclosing the microscope within a telescopic light-tight chamber, an exposure chamber is secured by the employment of the foldable bellows, B'. Said bellows is shown as attached at one end to an upper plate or head, K, which is provided with an opening, k, and with a recess, k', adapted to receive a plate holder H'. The plate or head, K, is adapted to be supported in a raised position by telescopic posts or standards, L, each consisting of a hollow member, l, and a rod l', the latter fitting in the hollow members and adapted to be held in any desired position therein by suitable catches, l^2. The posts are fastened to a suitable base, L', and when said posts are extended they support the head, K, at a proper height above said base. The microscope, the head, K, and the bellows are held steadily in place by suitable guy wires, m, which are fastened at their upper ends to the head, K, in a suitable way, the lower ends of said guy wires being fastened to eye bolts, m', adapted to be screwed into the floor. The lower part of the bellows, B', is provided with a plate, M, adapted for the reception of the upper part of the tube, e^2, of the microscope, said tube extending into the extensible light-tight chamber, A', secured by the employment of said bellows, B'. Between said microscope tube, e^2, and the plate, M, of the bellows is a light-tight coupling, G', which is somewhat similar in construction to the coupling, G, shown in Fig. 9, except that each member of the coupling, G', contains a plurality of flanges and said members coöperate to thoroughly exclude the light. As shown in said Fig. 3, the member, g', of the coupling is fitted around the tube of the telescope, whereas the member, g^2, is fastened in a suitable way to the plate, M, whereby said members may be assembled into interlocking relation for excluding the passage of light rays through the coupling into the chamber, A'. The microscope, E, is adapted to rest on the base, L', of the apparatus, and when said apparatus is in use, the rays of light from an arc lamp are thrown by the mirror, e^5, through the microscope so as to project an enlarged image of the subject onto the sensitized plate which is confined in the plate holder, H'. It is evident that the parts may be readily disconnected and packed within a small compass for convenience in transportation or storage.

The salient features of my invention may

be combined with a cabinet, O, in the manner represented in Fig. 4 of the drawings, wherein said cabinet, O, is represented as a desk intended to be used in a physician's office or other place of examination. The cabinet is provided with a permanent light-tight casing, B^2, which extends vertically therein, said casing being shown as provided with a hinged front door, b^6, in order that the microscope, E, may be easily and quickly placed in position within the chamber, A^2. In the rear of this casing, B^2, is arranged the arc lamp, J, which is shown as mounted on a rheostat, J', said rheostat and the lamp being of the same portable type as the lamp shown in Fig. 1. The casing, B^2, is provided in its rear side with an opening, g, for the passage of the light rays from the arc lamp, and across this opening is adapted to operate a slide or shutter, N, which may be operated in any convenient or suitable manner. As shown, however, a pull cord or rod, n, is fastened to the shutter and extends upwardly through the cabinet, O, and through an opening in the table, o, of said cabinet, the upper part of the rod or cord being provided with a suitable operating piece, n'. The rod or cord may be easily operated to lift the shutter and expose the opening, g, but when the pull on the cord or rod is released, the shutter, N, closes by gravity. The table, o, of the cabinet is provided with an opening, o', and with a suitable cap, o^2, which is grooved for the reception of the plate holder, H^2. Suitable means should be provided for securing a light-tight connection between the chamber, A^2, and the microscope. Said connection may be secured by using the bellows of Fig. 3, but it is preferred to employ the partition, D, in the chamber, against which partition the microscope is fitted so as to exclude the passage of the light rays from the lower compartment into the chamber, A^2.

The operation of the apparatus shown in Fig. 4 is similar to that described in connection with Figs. 1, 2, and 3, and it is not considered necessary to repeat the description of the operation at this point. The lamp, J, and the rheostat, J', shown in Fig. 4 are adapted for use in connection with the several forms of apparatus shown in this application, particularly the portable form of apparatus in Figs. 1 to 3 inclusive, for the reason that said lamp is mounted on, or supported by, the rheostat, J', and, furthermore, the carbons of the lamp are arranged in a peculiar position relative to each other for the purpose of projecting uninterrupted light rays on to the mirror or through the lens tube of the microscope. The rheostat, J', is shown as having two contact terminals, j, j, to one of which is fastened a conductor, j^2, leading from a switch, J^2. From the other terminal leads a conductor, j^3, which is attached to one carbon, J^3, of the pair of carbons, the other carbon of the pair being indicated at J^4. To this carbon, J^4, is attached another conductor, j^4, of the circuit leading from the switch, J^2, whereby the current is adapted to traverse the rheostat and the carbons of the arc lamp. As shown, said carbons, J^3, J^4, are pointed at their adjacent ends and they are, preferably, at an angle one to the other, instead of being in alinement, as in prior types of lamps. The carbons may be at an angle of 45° or 60°, or any intermediate or desired angle, the object being to so arrange the carbons as to keep the arc continuously in one place and to project the light rays toward the microscope mirror without casting a shadow and to utilize to the full the electric arc, for the reason that it is desirable to secure an intense light in the photographing operations in order to produce a clear sharp negative. The carbons are held by suitable clamps, p, each of which is carried by a rack, P, with which rack engages an adjusting spindle, p', which is suitably mounted in the lamp frame, p^2, the latter having a base, p^3, adapted to be fastened directly to the rheostat, J', the lamp base and the current conductor (resistance) of the rheostat being electrically insulated. The racks, P, afford convenient means for manipulating and adjusting of the carbons to suit the conditions of service, as well as to feed one or both carbons in order to compensate for consumption by the current, but, if desired, I may employ an automatic current controlled feed mechanism to make the carbons (one or both) approach each other and thereby maintain the arc subsequent to its establishment.

Fig. 5 of the drawings represents a type of apparatus which may be converted or adapted for use in connection with the microscope and the arc lamp as contemplated by the invention heretofore described for the purpose of producing successive photomicrographs on a continuous film, indicated by the reference character Q. The general form of the means for moving the film, Q, at intervals is similar to that employed in the production of films for "moving picture machines," hence I will not describe in detail the several working parts of the aforesaid mechanism. As shown, however, the film is adapted to be uncoiled from a spool, q, and to be coiled on a take-up spool, q', and as it passes from one spool to the other, said film is engaged by the feed wheels, q^2, and by suitable guides, q^3, which operate to hold the film in engagement with said feed wheels. Within the casing, Q', of said apparatus is a horizontal diaphragm or partition, Q^2, which is connected with the bottom of the casing by a light-tight coupling, Q^3. On this partition, Q^2, is mounted a sleeve, R,

the upper part of which is lined, as at r so as to make a tight joint with a collar, R'. This collar is adapted to contain a ground glass, R^2, which is across the lower part of a vertical sight tube, R^3, the latter extending upwardly within the casing, Q', and containing a suitable lens r'. Around the sight tube is fitted a double tube, R^2, which extends upwardly through the top of the casing, Q', and between the members of this double tube is arranged a lined eye piece, S, the latter having a cord or other suitable means, such as indicated at S', for holding the eye piece steadily in place over the eye of the operator. The lens tube, e^2, of the microscope is provided with a double flanged member, s, of a light-tight coupling, the other member, s', of which is fastened to, or otherwise engaged with, the partition, Q^2, so as to depend downwardly therefrom, whereby the microscope is adapted to be arranged in line with the sight tube, R^3, and the external rays of light are prevented from passing through the opening provided in the casing, Q', for the reception of the microscope.

The feed wheels and the take-up spool of the apparatus are adpated to be driven by suitable motor mechanism for the purpose of imparting traveling movement to the continuous film, Q, but this movement is given intermittently to said film by a suitable device adapted to be actuated by the motor mechanism. As shown, the device consists of a disk, S^2, which is provided with a member, such as a pin, S^3, that engages with the unsensitized face of the film. When this disk and its pin are rotated, the film remains practically at rest during a part of such rotation, but at another period of the rotation of the pin, the latter draws on the film for the purpose of moving it a predetermined distance. Said film is shown in Fig. 7 as having perforations near its edges, and the width of said film is less than the diameter of the sight tube, R, and the focusing glass, R^2. Said film passes between the sleeve, R, and the casing, R', so that it travels between the focusing glass, R^2, and the lens tube, e^2, of the microscope.

It will be understood that the operator may view the subject through the sight tube, R^3, for the reason that the image is projected by the microscope on the focusing glass, R^2, a portion of the subject being visible at the edges of the film. This enables the operator to adjust the microscope for securing the proper focus.

In the operation of the apparatus shown in Fig. 5 an enlarged image is projected by the microscope on to the sensitized surface of the film, Q. The motor being in operation, the disk, S^2, operates to advance a certain length of film across the tube, R, and the exposure is made so as to secure a latent image on said film. The film is now moved again by the disk, S^2, and it is coiled on the take-up spool, q', while a fresh length of film is uncoiled from the spool q. These operations are repeated to secure a desired number of impressions on the film, after which said film is developed and fixed in order to produce a record adapted to be employed in the so called "moving picture machines" for displaying a succession of pictures which represent the movement of the corpuscles of blood as it circulates in the human system, or as the cells move individually, whereby the apparatus is especially adapted for lecture purposes.

It is to be understood that the microscope E is employed in connection with the means for intermittently moving the continuous sensitized film, and that an electric lamp is employed to furnish the light required to secure an instantaneous photographic exposure. The microscope E is shown in Fig. 5 as being connected with the casing and the diaphragm Q^2 thereof by the light excluding coupling Q^3 embodying the internal overlapping tubes s s', and the external overlapping tubes shown, so that no light can pass into the chamber containing the sensitized film except through the microscope E.

In photographing specimens of the human blood for various purposes, particularly for medical use, it is desired to secure a record at different successive periods showing the movement of the corpuscles of the blood, as well as of the movement individually of the blood cells. This record is made from one or more drops of human blood drawn fresh from the patient, deposited on the microscope and immediately photographed, the operations being performed as expeditiously as possible in order to secure photographic exposures of the blood specimen while the corpuscles and cells are in motion. The use of the continuous film exposed rapidly and the employment of the intense light furnished by the electric arc are important factors in obtaining the records of the condition of the human blood, for the reasons that the electric arc furnishes the intense light to secure the instantaneous photographic exposures, and the intermittent movement of the film affording the necessary photographic surfaces on which the latent impressions of the enlarged images projected by the microscope are obtainable without involving the delay and loss of time required to change the common sensitized photographic plates.

In Fig. 5, the apparatus is shown as being arranged to direct the film to a horizontal path, and the microscope is arranged for its tube, e^2, to occupy a vertical position. In Fig. 6, however, the position of the apparatus is changed for moving the film in a

vertical path, and the microscope is adjusted in order that the rays of light from the arc lamp, J, may be projected directly through said lens tube, e^2, thus throwing the mirror, e^5, out of operation. In other respects the apparatus is similar to that heretofore described.

In Figs. 8 and 11 of the drawings I have shown a binocular adapted to be used in connection with the microscope for the purposes of focusing it, and for projecting two images on to a sensitized surface, or a plurality of sensitized surfaces, in order to produce stereoscopic photographs. The binocular, T, is provided with a tube, t, adapted to fit the lens tube, e^2, of the microscope, and said binocular is, furthermore, provided with the lens tubes t', t^2. Within said binocular are the prisms T', T^2, which are in alinement with the lens tubes, t', t^2, respectively. Said prism, T^2, is composed of two members separated by a thin stratum of air, and said prism is in alinement with the tube, t, whereby the rays of light from an image projected by the microscope on to the prism, T^2, will divide in a manner understood by those skilled in the art so that certain of the rays will pass through the prism; T', and the lens tube, t', while other rays of light will pass through the prism, T^2, and the lens tube, t^2. The images projected by the binocular strike the sensitized surfaces held in the plate holders, H^3, H^4, the latter being at an angle one to the other in order that the sensitized surfaces will be at right angles to the respective axes of the tubes, t', t^2, as shown in Fig. 8. Said plate holders are contained in suitable guides, u, of the upper part of the section, b', of a telescopic casing, the microscope and the binocular being arranged within said casing, as shown. It is evident, however, that the binocular may be fitted to the lens tube of the microscope in either form of the apparatus herein shown and described.

In Fig. 12 of the drawings there is shown another adaptation of the binocular, T, wherein it is combined with a microscope, E, and a continuous film camera, Q^5, for the purpose of viewing the subject and focusing the microscope while the exposures of the subject are taking place on the movable continuous film in the camera, the latter being of the type shown in Fig. 5. The binocular, T, is adjusted for the tube t^2 thereof to engage with the sight tube, e^2, of the microscope, E, and with the camera, Q^5 in a way to secure light-tight connection between the parts, whereas the tube, t', of the binocular is arranged for the operator to look into the binocular so as to obtain a view of the subject while the exposures are being made on the film of the camera, whereby the microscope can be adjusted at any time to secure the proper focus.

Having thus fully described the invention, what I claim as new, and desire to secure by Letters Patent is:

1. The combination of a casing constructed with a side formed with a light opening at its lower end, another side formed with an access opening, a head closing the lower end of the casing, a head closing the upper end of the casing and provided with an image opening and a recess for a plate holder, and a microscope, seated on the lower head and having a mirror provided with means located in a position whereby it may be adjusted without removal from the casing.

2. The combination of a casing constructed with a horizontal partition at its lower part, providing a mirror chamber and a magnifying chamber, a side formed with a light opening at its lower end, another side formed with an access opening extending opposite its lower end, a head closing the lower end of the casing, a head closing the upper end of the casing and provided with an image opening and a recess for a plate holder, and a microscope seated on the lower head and having a mirror provided with means located adjacent the access opening whereby the mirror may be adjusted without removal from the casing.

3. The combination of a casing constructed with a side formed with a light opening at its lower end, another side formed with an access opening, a finger opening near the lower end of the casing, a head closing its lower part, a head closing its upper part and provided with an image opening and a recess for a plate holder, and a microscope seated on the lower head having a mirror provided with means located in front of the finger opening whereby the mirror may be adjusted independently of the access opening.

4. The combination of a casing constructed with a horizontal partition at its lower part, providing a mirror chamber, a side formed with a light opening at its lower end, another side formed with an access opening extending opposite its lower end, a head closing its lower part, a head closing its upper part and provided with an image opening and a recess for a plate holder, a microscope seated on the lower head and extending through the partition having a mirror provided with means located in a position whereby it may be adjusted and a light tight closure between the microscope and the adjacent portions of the partition.

5. The combination of a casing constructed with a side formed with a light opening at its lower end, another side formed with a finger opening near its lower end, a head closing its lower part, a head closing its upper part and provided with an image opening and a recess for a plate holder, and a microscope seated on the lower head hav-

ing a mirror provided with means located in front of the finger opening whereby it may be operated to adjust the mirror independently of the other openings in the casing.

6. The combination of a casing constructed with a horizontal partition at its lower part, providing a mirror chamber and a magnifying chamber, a side formed with a light opening at its lower end, another side formed with an access opening at its lower end, a head closing its lower part, a head closing its upper part and provided with an image opening and a recess for a plate holder, a microscope seated on the lower head having a mirror provided with means located in a position whereby it may be adjusted, a slide adapted to close the light opening and means for operating the slide from a point adjacent the top of the casing.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT L. WATKINS.

Witnesses:
JAS. H. GRIFFIN,
H. I. BERNHARD.