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The Epidiascope

CARL ZEISS

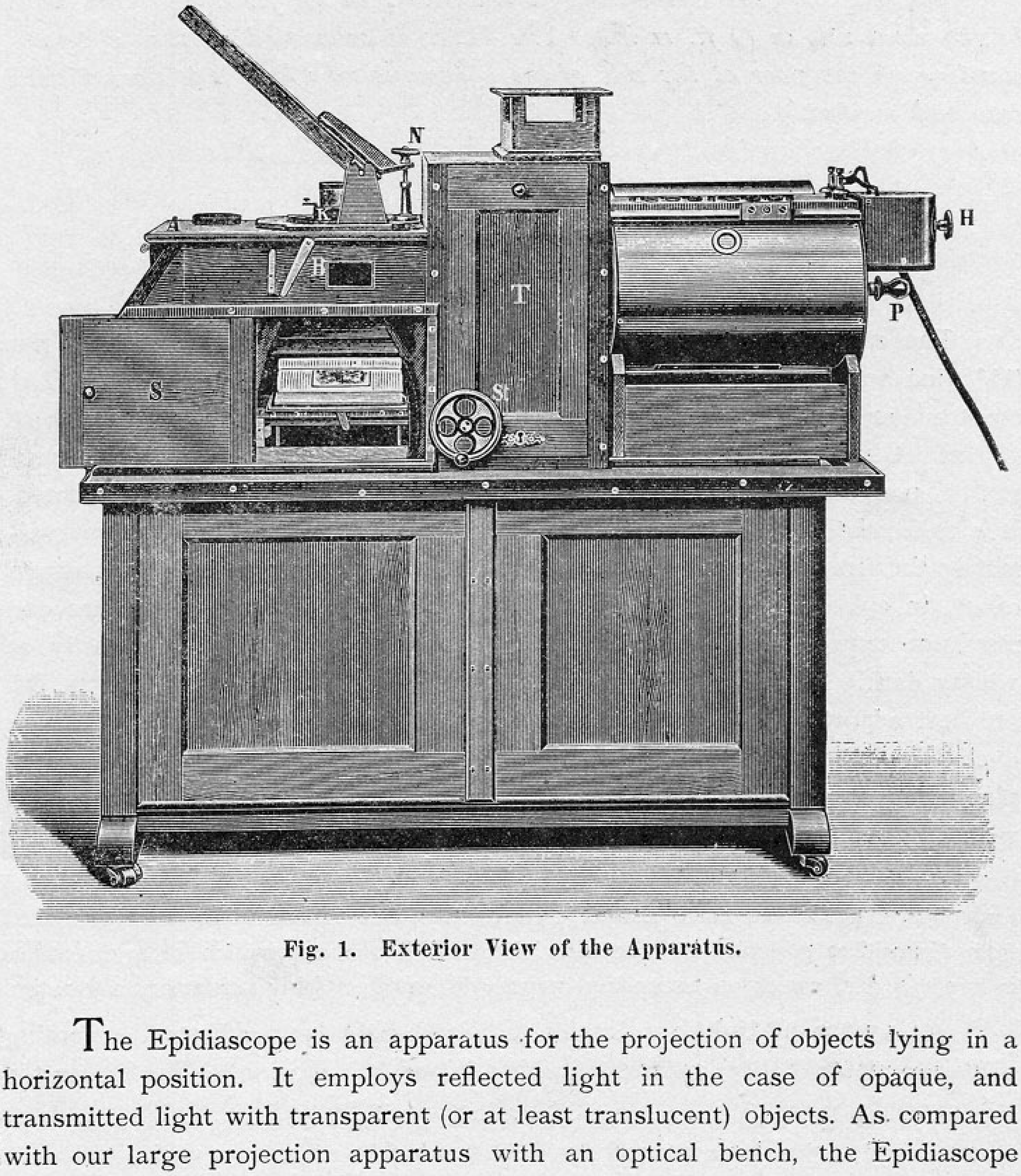

Fig. 1. Exterior View of the Apparatus.

The Epidiascope is an apparatus for the projection of objects lying in a horizontal position. It employs reflected light in the case of opaque, and transmitted light with transparent (or at least translucent) objects. As compared with our large projection apparatus with an optical bench, the Epidiascope possesses the following characteristic advantages, viz:

1. Greater latitude in the shape and size of objects.
2. When reflected light is employed, the illumination is more perfect.
3. Transition from operation with reflected to transmitted light is effected with greater speed and convenience.
4. The apparatus is easily adjusted for projection obliquely upwards.
5. The several component parts are better protected against dust and improper usage.

On the other hand, owing to the absence of the optical bench, the Epidiascope lacks somewhat the manysidedness of application so characteristic of our large projection apparatus; in particular, the Epidiascope is not available for direct projection of microscopical preparations under high magnification, nor for photo-micrographic work.

The length of the Epidiascope is about 1 1/2 m (4 ft. 11 in.), the total height about 1 1/2 m (4 ft. 11 in.). The latter is calculated so that a person standing on the floor at the side of the apparatus may be able to work it with ease and comfort.

Range and conditions of use.

The width of **objects to be projected** may not be more than 30 cm (11 3/4 in.) and the maximum thickness must not exceed 16 cm (6 1/4 in.). The construction of the apparatus prescribes no defined limits to the length of objects. Given objects of this description, the apparatus is adapted for projection over a circular area of 22 cm (8 5/8 in.) diameter, uniformly illuminated. It is essential that details which are to be sharply defined should lie in approximately the same horizontal plane and that the objects should admit of the passage of, or, in episcopic projection, reflect sufficient light. In the latter case one may not expect satisfactory representations of objects which are partly or wholly dark. Hence it follows that diapositives, many natural objects, &c. are best adapted for projection by means of transmitted light, whilst pictures (including plates in books), drawings, small models, physical apparatus, small plants and animals, or parts of large ones, &c., are applicable to operations with reflected light.

Copies on the usual kinds of photographic paper cannot, as a rule, be recommended for episcopic projection, much sharper pictures, with well defined details, being obtained from diapositives projected by transmitted light. When the provision of a diapositive is impracticable, copies on transparent paper will supply a fairly satisfactory alternative.

As **source of light** we employ a search-light lamp adjusted, according to requirements, for a current of either 30 or 50 ampères[1]). To ensure the

[1]) In making a selection it must be borne in mind that many distributing centres do not afford a current of 50 ampères, hence it is well first of all to seek definite information on this point.

satisfactory working of these lamps a **continuous current** is indispensable, and they require, allowing for resistance at the terminals, a potential of about 65 volts. As, however, the currents supplied by power-distributing centres are usually of higher potential (amounting to 110 or 220 volts), part of this energy must be reduced by a resistance coil. However desirable it might be to avoid such a waste of electrical energy by reducing the pressure of the current, as transmitted from the dynamo, to the required lower degree, this is only possible by means of costly (continuous-current) transformers. Again, if only alternating or three-phase currents are available, equally expensive appliances are required to transform them into continuous current.

The objective supplied with the apparatus cannot be exchanged for one of different focus without special adaptation. Hence the degree of **magnification** can only be varied by altering the distance between apparatus and screen. For convenience of movement the apparatus is provided with 4 castors. In many situations it would be practicable to supply guides for the castors by letting one or two |____|-shaped plates into the floor. The available magnification depends on the candle power of the source of light, the method of illumination, and on the size and nature of the objects.

If equipped with the **small** (30-ampères) search-light lamp, the apparatus is capable — taking as object a piece of printed matter or a black and white drawing — of magnifying a uniformly illuminated area of 22 cm ($8^5/_8$ in.) diameter **9 times.** When, however, the object is of smaller dimension, the illumination may be restricted to a smaller field by altering the position of the reflector, the intensity of the light being at the same time increased to such an extent as to allow of a **magnification of 25 diameters** being attained. The highest degree of intensity is reached when the brightly lighted portion of an object is restricted to a diameter of about 8 cm ($3^1/_8$ in.). The objective of the Epidiascope is, as a rule, selected so as to yield the $\times$ 9 magnification at about $2^1/_2$ m (8 ft. 2 in.), the $\times$ 25 magnification at about $6^1/_2$ m (21 ft. 4 in.) from the screen. The distance to the screen is to be understood as measured from the front of the objective.

When working with less favourable objects, one must be content either to show only part of the object, or to suffer a proportional decrease of magnification.

Transmitted light, especially in the projection of diapositives, affords by far the greatest scope in the choice of magnification.

This is explained by the fact that, irrespective of absorption, nearly the whole of the light directed on the object enters the objective opening and helps to form the image, whereas in working with reflected light only a relatively small portion of the light thrown back by even the lightest parts of an object passes through the objective, however excellent the latter may be, the remainder being lost owing to irregular reflection from all sides.

If the apparatus is equipped with the **larger** (50-ampères) lamp, a correspondingly higher magnification is available. Instead of about $\times$ 9 to $\times$ 25, it would then be about × **14** to × **37.** The corresponding distance of the screen would vary from $3^3/_4$ to $9^1/_2$ m (12 ft. 4 in. to 31 ft. 2 in.).

It is, of course, understood that the use of stronger light entails a corresponding increase of heat. It is true, the water chamber absorbs the ultra-red rays not affecting the eye, but the physiologically active rays issuing from the centre of the spectrum are capable of heating the object considerably, whenever they are sufficiently intense and the object receiving them sufficiently absorbent; this absorption of visible rays occurs in all brightly coloured bodies. If such objects are succeptible to a somewhat high degree of heat, care is required, particularly when a lamp of 50 ampères is in use.

When using a current of 30 ampères a screen of about 2 × 2 m (6 ft. 7 in.) is required, with a current of 50 ampères one measuring about 3 × 3 m (9 ft. 10 in.) is necessary.

The linen sheets so commonly used allow much light to pass through, as will readily be seen on inspection from the back when the apparatus is in operation, and all this light is positively lost to the spectator in front. Hence we recommend the use of opaque screens made in the following manner. A space on a wall, or a screen of millboard or linen, is painted with zinc white prepared with water and size, and dusted over with powdered chalk just before the coat of paint becomes dry. Such a colouring can be easily renewed whenever necessary.

The position of the screen depends on the kind of erecting mirror employed. If the mirror is a fixed one, the screen must be vertical, its centre about $1^1/_3$ m (4 ft. 4 in.) above the level of the apparatus; if adjustable, the screen must incline at a corresponding angle, and its centre must be somewhat higher than in the former case (see p. 8).

Transparent screens — spectators and apparatus being on opposite sides — cannot be used for episcopic projection.

Method of Working.

Figures 2 and 3 give a general idea of the working of the apparatus.

Figure 2 illustrates the procedure by **reflected light** (episcopic projection).

The light emitted by the crater of the positive carbon falls upon the parabolic mirror of the lamp and is thence reflected in the shape of a nearly cylindrical pencil. It next passes through the cooling chamber (which is filled with water and performs the function of absorbing heat rays), then strikes mirror I and is by it reflected obliquely from above through the diaphragm and upon the object immediately below. From the object the light is diffusely reflected upwards. Of the reflected rays only those which are confined in their passage to the space marked off by the dotted lines reach the objective. The cone of rays travelling upwards through the objective meets the erecting mirror, and is finally reflected upon the screen.

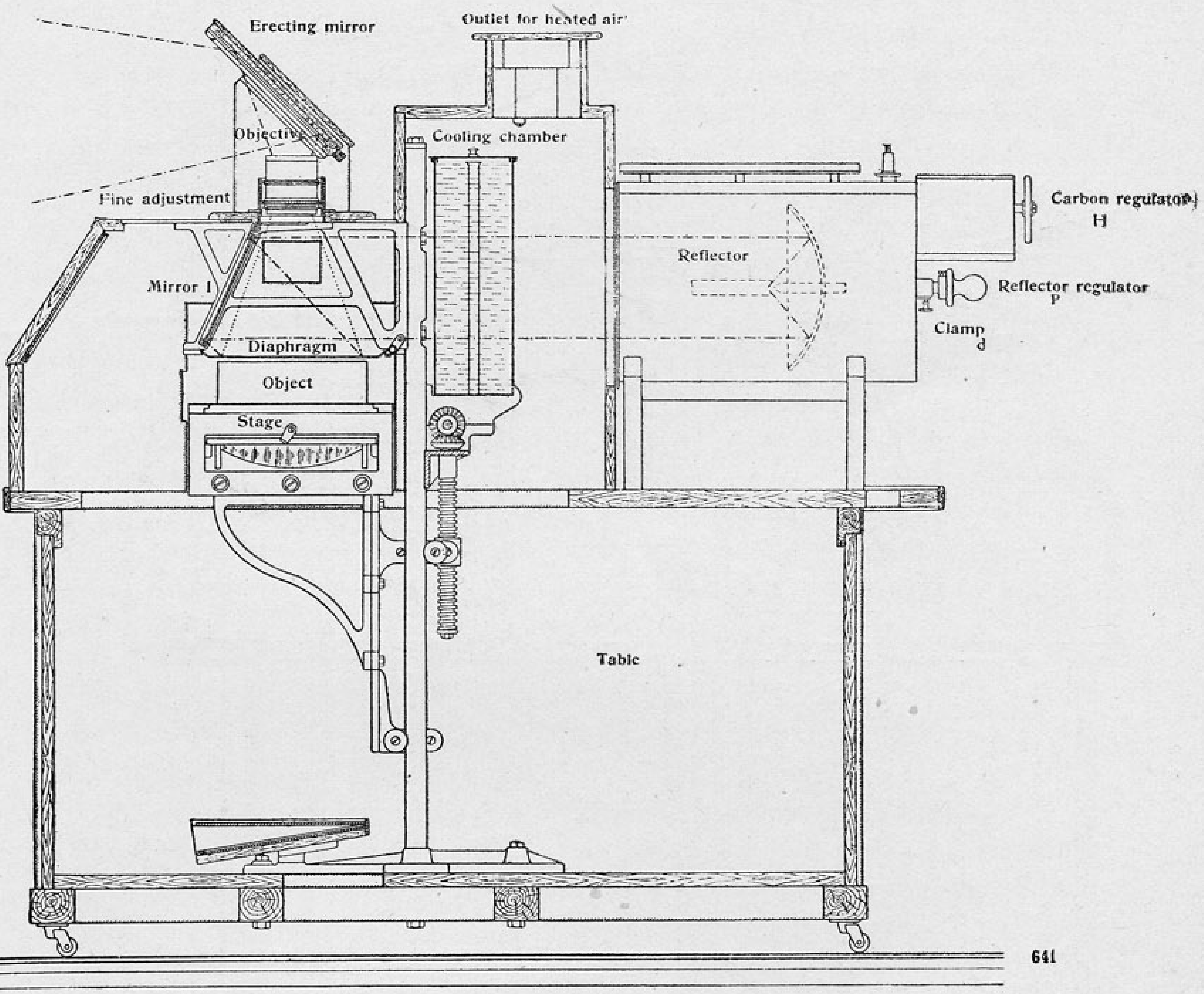

Fig. 2. Diagram showing the path of the rays by reflected light.

Fig. 3 illustrates the procedure by **transmitted light** (diascopic projection).

Mirror I is here turned back, allowing the pencil of rays to pass to mirror II. From there it is reflected obliquely downwards upon mirror III. which again reflects it vertically upwards into the condensing lens situated below the object stage. Leaving the condenser, the rays of light pass through the transparent object, forming a reduced image of the search-light reflector near the projection objective. They next pass through the objective and meet the erecting mirror. The latter is shown in the illustration as fitted with a regulator. The position of the mirror, as here shown, is that required for projecting the picture obliquely upwards.

Manipulation of the Apparatus.

With regard to the different parts of the apparatus and the method of using them, the following points deserve attention.

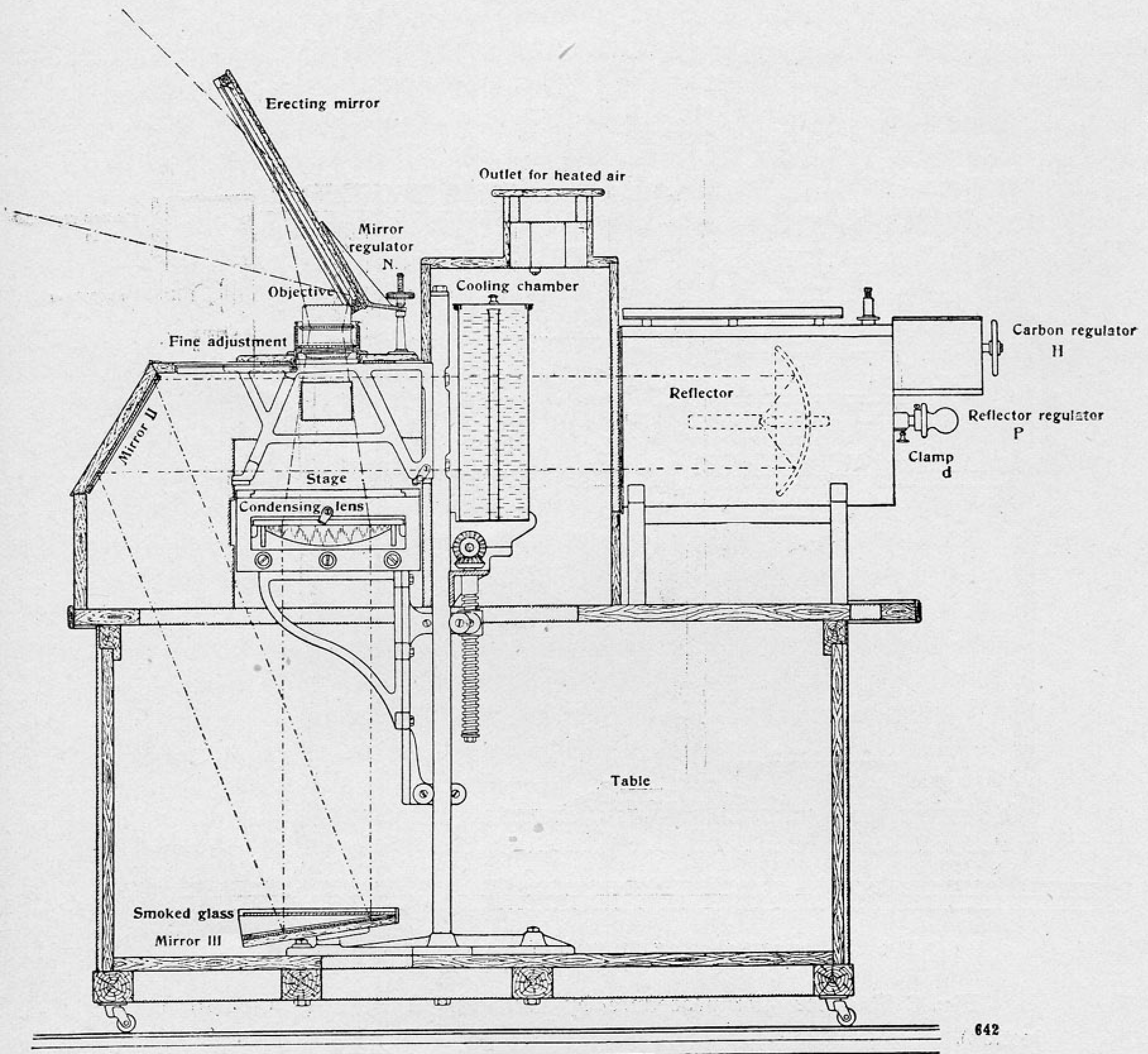

Fig. 3. Diagram showing the path of the rays by transmitted light.

The illumination is produced by means of a **Search-Light Lamp,** Model *KL* of the Arc-Light Manufactory of Messrs. Körting & Mathiesen, Leutzsch-Leipzig, with automatic carbon regulator and arc formation. The carbons are adjusted horizontally, with their axes not strictly converging. The thickest (the positive) carbon is turned towards a German silver reflector. The period of combustion of the carbons extends to about 3 hours. When the carbons are nearly consumed, warning is given by an unremitting noise issuing from the regulator action, and the arc finally expires spontaneously. The burning of the carbon holders is therefore impossible in a lamp of this construction. Access to the carbon holders is gained by means of a side door.

When fresh carbons are required, the regulator wheel "*H*" is first turned in the direction of the index hand, thereby separating the carbons. When so far apart that the clamp of the negative carbon holder is close to the surface of the reflector — which, by the use of the reflector regulator "*P*", has been set back as far as possible — the burnt out negative carbon is removed by means of the long key provided for the purpose. This key is introduced through a passage running through knob "*P*", and turned towards the index hand. This done, a fresh carbon is substituted for the burnt stump. Next, the screw which presses the movable jaw of the positive carbon holder against the carbon is loosened by means of a shorter key, the burnt carbon is removed and, the distance between the carbons having, if necessary, been further extended by a turn of wheel "*H*", a fresh one is inserted and secured by tightening the screw.

Before admitting the current, see that the carbons are not in contact, but rather 3 or 4 mm (about $^1/_8$ in.) apart. When in operation, the arc may be watched through a dark glass in the door of the casing.

Whenever necessary, the **reflector** can be taken out by removing, with a specially provided tool, the screw nut which holds it in position. It may then conveniently be cleaned with clean cotton or linen rags by the application of a polishing fluid, consisting of equal parts, by weight, of strong solution of ammonia, water and pure powdered chalk. Small particles of carbon adhering to the surface should first be removed with a soft camelhair brush.

The position of the reflector can be altered by means of the regulator "*P*" which comes into play after clamp "*d*" has been unscrewed. The light proceeding from the reflector and again reflected by the mirror I passes on to the plane on which the objects are placed for exhibition, equally illuminating an area of from 8 to 22 cm ($3^1/_8$ to $8^5/_8$ in.) according to the position of the reflector. If the knob "*P*" is drawn out, the reflector moves away from the carbon crater and the illuminated area decreases, but the light is intensified; if pushed in, the reflector approaches the carbon crater and the illuminated field expands, whilst the intensity of the light diminishes.

When not in use, the projection lamp is protected by a cover furnished with lock and key.

A cooling chamber for absorbing heat rays is placed in the central space to which access is gained by opening the doors "*T*" (Fig. 1). This cooling chamber is a deep tank about $4^3/_4$ in. thick (12 cm) with sides of plate-glass which is to be filled with cold water. After the apparatus has been in use for from $^1/_4$ to $^1/_2$ hour, and if still required to continue in work, a current of water must be slowly passed through the chamber. An expenditure of $^1/_2$ litre (about $^3/_4$ pint) of water per minute will suffice. The water tubes are put over joints which project from the wooden casing at "*G*". The inside connection with corresponding joints on the water chamber is effected by means of short pieces of indiarubber tubing. The supply tube is connected with the joint fitted with a tap, the other tube is slipped over the second joint.

For the purpose of cleaning the cooling chamber the water must first be discharged by the tube — usually by the supply tube. The board connected with the hot air outlet is then taken off, which is easily done after removing the fasteners accessible by the door "*T*" The chamber may then be lifted out without difficulty. **On no account should any attempt be made to remove the cooling chamber when full of water** as, on account of the great weight (about 16 kg = $35^1/_4$ lbs.) of the water, the chamber would be likely to become leaky, or the glass plates might even break.

The lamp should never be left burning if the cooling chamber is not properly filled with water.

Optical Equipment.

With the outfit as usually supplied we employ as **objective** our Planar, series I^a, No. 13. This lens combines a relatively large angle with the rapidity demanded for projection by reflected light, its relative aperture being 1 : 4. Its focal length is 250 mm ($9^7/_8$ in.). During use the iris-diaphragm of the objective should be fully opened. Objectives of greater focal length may be used, but their employment necessitates special structural adaptation of the apparatus. Objectives of shorter focus cannot be adapted.

The use of an objective of greater focal length would be advisable where the projection distance is greater than that indicated above and where no increase of magnification is desired with the consequent diminution of the brightness of the image on the screen. The size of the erecting mirror and its cost of production increase in proportion to the greater focal length of the objective entailing a proportionate advance in price.

The objective is specially fitted with an attachment for fine focusing, which is worked by a milled ring "*K*" (Fig. 1, 2 and 3).

In order that the objective may be also available for camera work, we always add the necessary flange as well, although this is not required for the Epidiascope.

The **erecting mirror,** which is situated above the objective, performs a double function — that indicated by its name, and that of projecting the image upon a perpendicular, or inclined, plane surface — and is situated above the objective. The mirror is supplied in two different forms, either fixed at a certain angle (Fig. 2), or with adjustable inclination (Fig. 1 and 3)

The fixed mirror stands at an angle of 45° to the horizon and only admits, as already mentioned above, of projection on a perpendicular plane whose centre lies $1^1/_3$ m (4 ft. 4 in.) above the level of the apparatus.

With the adjustable mirror the angle may be widened from 45 to 60°, by means of the mirror regulator "*N*" (Fig. 2 and 3), with the effect of declining the axis of the cone of rays issuing from the objective to an angle of 30° to the horizon. In this case the screen must be raised correspondingly, and be inclined to such an angle as to receive the cone of the rays approximately perpendicularly to the axis of the latter; otherwise a distortion of the image would result, with consequent prejudicial effect on the clearness of the picture.

The erecting mirror consists of a glass mirror, silvered on the front surface. For protection against chemical or mechanical action a wooden cover is provided, lined with blotting-paper impregnated with a solution of sugar of lead. When dusty, the mirror may be **carefully cleaned with a brush** specially provided with the apparatus. Cleaning the glass with very soft, well washed linen or fine leather is permissible, but this must be done with scrupulous care and exactness. The cost of renewing the coating of silver is, however, very slight.

The frame bearing the mirror and the projection lens admits of being set, not only in the position shown in Figures 1—3, but also in such a manner that the whole structure appears to have been turned by 90° round the optical axis of the objective; in this case the apparatus must be turned broadside to the screen.

When the apparatus is not in use, the erecting mirror is lifted from its bearings, the frame including the objective is taken down, and the whole stored in the lock-up case forming the base of the apparatus. The opening thus caused is covered over with a lid.

Projection of opaque objects.

In the projection of opaque objects **mirror I** is put into the position shown in Figure 2. For this purpose it is suspended from a horizontal axis, around which it can be swung by means of the lever *B* (Fig. 1). In the position shown in the illustration it reflects the light obliquely downwards and through the opening of a diaphragm (to be further described below) upon the object stage.

Access to the **object stage** may be gained from either side by opening the sliding doors *"S"* (Fig. 1). It consists of a frame provided with two slide bars into which one of the four **carriers** supplied may be inserted. For opaque objects the carriers with solid bottom will naturally be most frequently employed. The longest carrier affords the convenience of enabling one to arrange specimens outside the structure before sliding it in, and it also facilitates a rapid change of objects. Whenever the apparatus is to be served from one side only, the shorter carriers are preferable.

The light of the lamp being very intense, it is advisable to avoid looking at the objects direct, but to observe them only through the windows fitted above the sliding doors *"S"*

The proper focus is obtained by raising or lowering the object stage.

The movement of the stage is practicable within fairly wide limits, and can be accomplished from either side by turning a small wheel *"St"* (Fig. 1).

The available field of view is defined by means of blackened **diaphragms** (Fig. 2) with graduated round or square openings. The tendency in drawings, and similar objects, to curl up may be counteracted by raising the stage so that, by contact with the diaphragm, the objects are held down flat. The focusing must then be done by means of the movement attached to the objective.

Black curtains are fitted to draw over the sliding doors for the purpose of preventing the escape of light and rendering it unnecessary to close the doors every time an exchange of objects takes place

Projection of transparent objects.

During the projection of transparent objects **mirror I** is turned back by means of lever *"B"* (Fig. 1), so as to occupy the position indicated in Figure 3 (under the roof of the case below the description "Fine adjustment"). It is held in this position by a spring. Knob *"P"* of the reflector regulator must be pushed home and the diaphragm is, if necessary, to be removed from above the object stage.

Having been reflected twice in succession by **mirrors II and III** (Fig. 3), the rays of light enter the large condensing lens situated below the object stage. They pass twice in their track through a plate of **smoked glass,** fitted horizontally above mirror III. The purpose of this plate is to compensate, by absorption, the glaring effect of the difference in intensity which is noticeable in changing rapidly from transmitted to reflected light (see p. 5 and Fig. 3).

If objects which are not highly transparent are to be projected by transmitted light, or when it is desired to increase the magnification by moving the apparatus further from the screen, the plate of smoked glass must, of course, be removed.

For the projection of pictures on glass the object stage is equipped with **special carriers** which slide in like the carriers for opaque objects already discussed above. The correct position of the carrier is denoted by the click of a spring. This carrier has two square openings, large enough to accommodate various sizes of slides not exceeding 13×18 cm ($5^1/_8 \times 7$ in.). Unless instructed otherwise, we supply frames for slides measuring 13×18, 9×12, $8^1/_2 \times 10$ and $8^1/_2 \times 8^1/_2$ cm ($5^1/_8 \times 7$, $3^1/_2 \times 4^3/_4$, $3^3/_8 \times 4$ and $3^3/_8 \times 3^3/_8$ in.). Two small bottom boards are also provided to facilitate an occasional change to projection of **opaque** objects without changing carriers.

Different sizes of diapositives projected at the same screen distance, i. e., the same magnification, produce pictures of varying size but of equal brightness. If notwithstanding the difference in size the objects are to be projected in the same proportions on the screen, the magnification (the distance of the screen) has to be increased as the size of the diapositives diminishes. The brightness of the pictures naturally decreases in proportion to the square of magnification (of the screen distance). Whenever diapositives and opaque objects are to be projected alternatively in rapid succession, size 13 × 18 cm is recommended for the former; this ensures sufficiently large pictures appearing on the screen, even though regard to the opaque objects necessitates the employment of low magnifications.

Diapositives falling within a circle of less than 8 cm diameter — microphotograms, for instance — can also be projected by means of the projection microscope mentioned below. At the same screen distance the magnification produced by this instrument with a **100 mm** Planar is about 2,5 times higher than that given by a **250 mm** Planar.

As the shape of objects may not always fit the ordinary carrier, we also add a short one with a **circular opening.** There being a space of 6 cm ($2^1/_2$ in.) between the condensing lens and the object stage, it is quite possible to show the surface of thick transparent objects.

Mirrors II and III, as well as mirror I, require a periodical cleaning with **old** linen or leather. Being silver-plated on the reverse side, they are far less sensitive than the erecting mirror. Access to mirror II is gained by turning up the supporting wall, like the flap of a desk; mirror III is reached by opening a sliding door in the substructure.

The condensing lens also requires to be cleaned occasionally, and it can readily be removed with the mount from its position below the object stage by releasing the catches holding it in place.

We also manufacture an

Episcope.

This apparatus is **only** applicable to projection by **reflected light.** The mirror I is a fixture in the position shown in figure 2. Mirrors II and III and the condensing lens are dispensed with.

The length of the apparatus is only about $1^1/_4$ m (4 ft. 1 in.); in other respects it corresponds to the specifications of the Epidiascope.

Micro-Projection.

We supply an apparatus **(the projection microscope for the Epidiascope)** specially adapted to use our Planars $f = $ **20** to $f = $ **100 mm** ($^4/_5$ to 4 in.) and low-power microscopic objectives. Particulars regarding this instrument will be found in special "Directions for use"

Net Price List

		Duty Free	Duty Paid
C 965	**Epidiascope** as described, with search-light lamp adjusted for a continuous current of 30 amperes, adjustable erecting mirror and fine focusing movement; but without resistance coil or projection lenses	$316.00	$455.00
C 966	**The same apparatus,** but with fixed erecting mirror	307.00	440.00
C 967	**The same** as C 965, but with 50 ampere lamp	345.00	495.00
C 968	**The same** as C 966, but with 50 ampere lamp	335.00	480.00
C 969	**Episcope** with search-light lamp adjusted for a continuous current of 30 amperes, adjustable erecting mirror and fine focusing movement; but without resistance coil or projection lenses	270.00	385.00
C 970	**The same apparatus,** but with fixed erecting mirror	260.00	375.00
C 971	**The same** as C 969, but with 50 ampere lamp	296.00	425.00
C 972	**The same** as C 970, but with 50 ampere lamp	286.00	415.00
	As lens system we recommend:		
C 973	**Planar,** series Ia, No. 13, f=250mm (9⅛ in.)	109.00	155.00
C 974	**Unar,** series Ib, No. 7, f=255 mm. (10 in.)	66.00	93.50
C 975	**Extra Brass Diaphragms** with openings, other than of those supplied	1.65	2.40
C 976	**Extra Carriers** for sizes of plates not provided for; each	1.75	2.55
	Replating a fixed erecting mirror of the usual size		6.00
	Replating an adjustable erecting mirror of the usual size		10.00
	Adjustable Resistance Coils for a main circuit of 110 volts. The current can be cut off by the regulating lever.		
C 977	For a current of 30 amperes	23.50	33.50
C 978	For a current of 50 emperes	39.50	56.50
	Packing complete apparatus (in 3 cases)	10.00	10.00