

**A UNIVERSAL PROJECTION LANTERN.**

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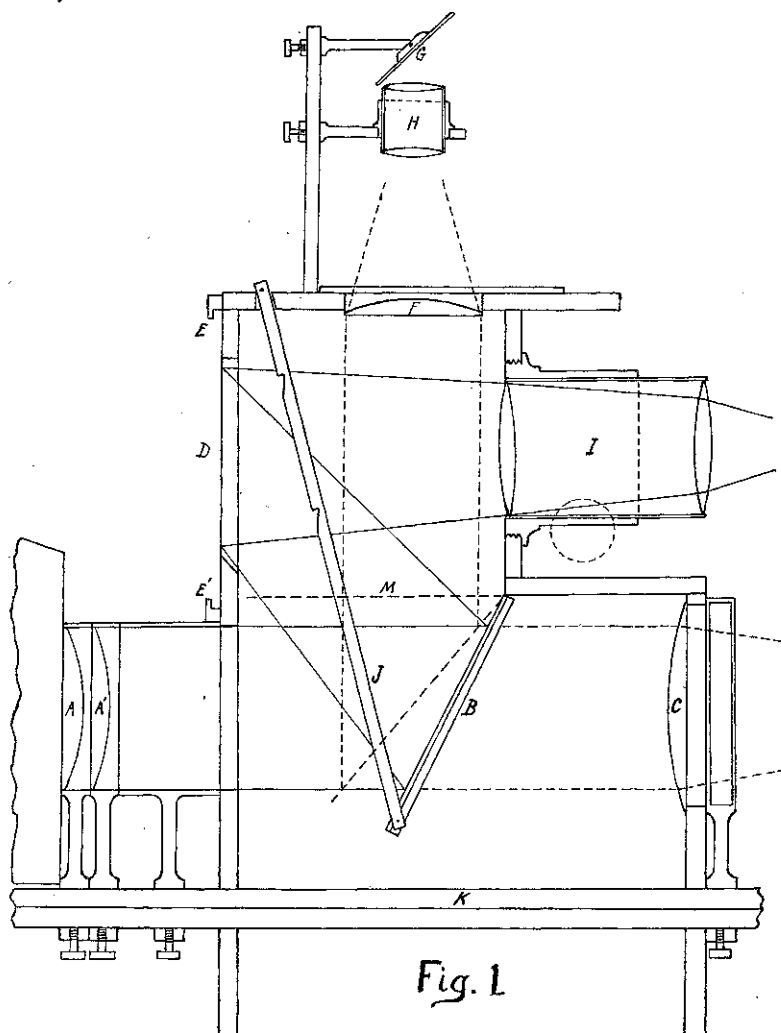
The projection lantern is without exception the most essential piece of apparatus of the modern lecture room equipment for the teaching of science, and especially in the physics department. To meet the diversified demands of the teacher, the lantern must be able to project photographic slides, microscopic slides, apparatus both transparent or opaque, by either horizontal or vertical projection, and printed diagrams of every nature. These various types of projection must frequently be alternated during a lecture. It is therefore of prime importance that a lantern projects everything directly forward, without rotating the lantern, and without alternating the objectives or other accessories, so that a change in type of projection can be made without much loss of time.

Some of the many other requirements of such a lantern are:

1. A large vertical gap for the projected apparatus.
2. A large 6" front condenser, so that apparatus of some size can be projected.
3. A complete control of the position of the arc in all directions.
4. A control of the intensity of illumination.
5. A light proof, well ventilated covering over the arc, to render the image visible through contrast.
6. A rapid and optically accurate device for replacing condensers when broken, or of improper focal length.
7. A good ventilating device for the condenser cells.
8. No multiplicity of mirrors—especially in front of the objectives—that reduce the illumination and distinctness of the image.
9. Condensers, objectives and all other parts must be in optical alignment and sufficiently stable to remain in position.
10. Slide holders for postal cards, etc., that will prevent the warping due to heat.
11. A method for reinverting the image of projected apparatus.

Almost innumerable other requirements could be mentioned: the above are only a few of the most essential. For a universal lantern, adaptable to every conceivable use, the absolutely essen-

tial requirements are: First, the interchange from any one to any other type of projection in about one second of time; and second, results for each type of projection as nearly perfect as if the lantern were constructed for that one kind of projection only.



Many good lanterns are on the market, but they are not sufficiently universal. This prompted me to make one that would more nearly meet the demands of the science teacher. The results obtained have been so uniformly successful as to warrant the writer making his ideas public.

Figure 1 represents a cross section of the lantern. The condensers A and A' are  $4\frac{1}{2}$ " in diameter and of  $5\frac{1}{2}$ " and  $6\frac{1}{2}$ " focal length. Parallel light strikes the plane mirror B and is reflected to D, where the picture, or object to be projected, is held. The objective I has a back focus of about 8" and magnifies an ordinary postal card, on a screen fifteen feet away, to about six feet square.

A lever J, with several notches cut in it, is fastened to the mirror B. On raising the lever to the second notch the mirror is adjusted at angle of  $45^\circ$  to the square optical bench K, so that the light passes vertically through the condenser F, the object to be projected, and the objective H. By means of the plane mirror G, the image is thrown on the screen wherever desired. Instead of this mirror a totally reflecting prism could be used advantageously.

On raising the lever to the last notch the mirror is elevated to M, so that the light passes directly through the large 6" condenser C, in front of which are mounted the various accessories needed in any particular case. The vertical gap from the center of the front condenser to the optical bench is  $6\frac{1}{2}$ ", but where a deeper one is required the optical bench can be made in two parts, with a short gap between the condenser and the objective.

A large 6" condenser is used, so that apparatus of some size can be projected. The arc is then pushed somewhat closer to the rear condenser, so that the conjugate focus of C is moved outward, but this is advantageous, as the objective must also be moved in the same direction. When slides are projected the slide holder acts as a diaphragm and diminishes the chromatic aberration.

Figure 2 illustrates the lantern when mounted for use. The lighthouse is higher than necessary by about 4" and is also too close to the dark chamber containing the adjustable mirror. It should be moved back about 4", which could easily be done by placing an absorption cell or a metal frame between the rear condensers and the dark chamber. These alterations would give ample space for holding any opaque object, or illustrations from a book, at the opening from which these are projected, without any danger of burning the hands of the operator.

The double frame holding the objective used for projecting slides is hinged, so that it holds not only the regular  $\frac{1}{4}$  plate objective, but a projecting microscope also. By means of the

hinge either the objective or the microscope can be swung into alignment, directly above the optical bench.

About one thousand illustrations from various catalogues and text-books were mounted on stiff black cardboard 4x5" in size, and indexed. Holders for these cards were made of heavy black-

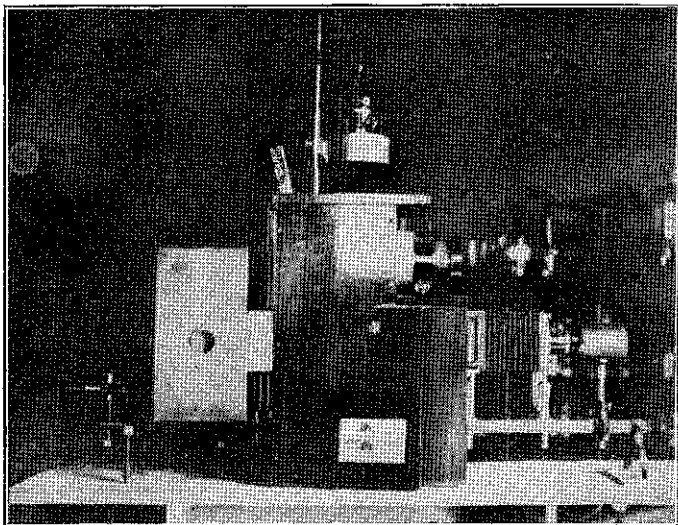


Fig. 2.

ened brass, as illustrated in Figure 3. By pushing on A, the strips B and B' are raised slightly, so that the cards and a plate of tin can be pushed into position. On releasing A the cards are clamped tightly, so that the heating does not produce any

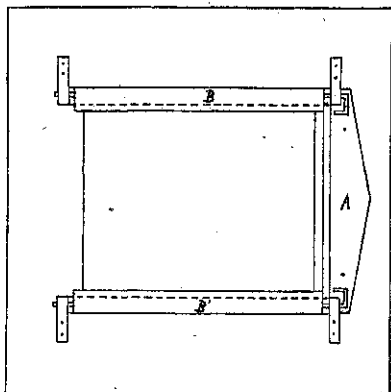


Fig. 3.

appreciable warping and consequent deformation of the image. Two similar holders for illustrated postal cards were also made. These holders fit into the spring guides E and E', Figure 1, and can be replaced as rapidly as any photographic slide. An illustration from any book, or for that matter any object, can be shown by simply holding it inverted before the opening D, Fig. 1.

To interchange vertical, opaque and direct apparatus or photographic slide projection it is thus only necessary to set the lever J at the proper notch, while the microscope can be swung into alignment by merely turning the top part of the lower objective holder. A change from any one to any other type of projection can be made in about one second of time and in every case the image is formed directly in the center of the screen.

With a single phase, 60 period alternating current of about 20 amperes, the opaque projection of diagrams, illustrations and postal cards is very satisfactory, provided cored carbons are used and that the image is not over seven feet square. With the direct current the illumination is necessarily much better. In the latter case the positive carbon should be horizontal and the somewhat smaller negative carbon vertical. When the alternating current is employed both carbons should be of the same diameter and held at an angle of about  $35^\circ$  to the optical bench.

The above described lantern has been thoroughly tested during the last school year and, with the slight alterations suggested, meets all the conditions of simplicity, rapidity of operation, universality and efficiency that a teacher could possibly desire.

### AN INTERESTING EXPERIMENT INVOLVING ARCHIMEDES PRINCIPLE.

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Take a demonstration hydrometer (or simply a wooden rod about 25 cm. long), and load one end with lead, if necessary, until it will sink when put into kerosene, but float when in water with about one-twelfth of its volume above water. Now place the loaded rod or hydrometer into a tall jar containing just enough water to float it (Fig. 1). Next pour kerosene into the jar on top of the water until the rod is entirely covered (Fig. 2). It

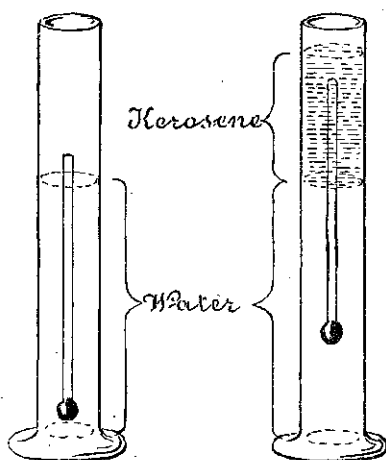


Fig. 1.

Fig. 2.