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with Compliments.
P. E. Nobbs

An Ideal North Lighting System

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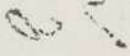
An Ideal North Lighting System

APPLICABLE TO
PICTURE GALLERIES, MUSEUMS, STUDIOS,
WORKSHOPS AND LABORATORIES

PATENTS APPLIED FOR
MARCH, 1934



Installations under this system involve the general design and layout of premises and particularly of roof structure. Until further notice consulting and other services in this connection will be provided by the inventor, Mr. Percy E. Nobbs and Mr. E. Godfrey Burr, in collaboration.

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AN IDEAL NORTH LIGHTING SYSTEM

WORKING LIGHT

However desirable sunbeams may be within habitable rooms, they have no place at all in enclosures where hand-and-eye-work is conducted, or where objects are displayed for appreciation. Vision, without fatigue, is largely a matter of continuous stimulation of the photochemical liquid **throughout** the retina—hence a **diffusion** of moderate light is necessary in such enclosures. Acuity of vision is dependent on **differention** of light and shade—hence, for delicate work a flux of light suitably **directed** on the object is required. Sensitivity to colours varies both with the strength of light and with the tint of the light. The full range of spectral colours can only be appreciated under **white light of about 12 foot candles** illumination. The presence within the field of vision of a source of illumination, or even of a small area of high illumination (a patch of sunlight on a floor, for example), causes accommodation of the eye to this brightness, with consequent loss of power to see properly the work in hand or the object under display even when these are suitably illuminated.

What is meant by good working light?

(1) For seeing paintings in a gallery, white light at 12–15 foot candles, and at an angle of incidence of not over 40° to the horizontal is the main requirement.

(2) For studying engravings the light need not be quite white, and may be of 15-20 foot candles, and should fall at an angle as before;

(3) For draughting (black and white work) the light need not be quite white; a diffused light of about 6 foot candles, falling on nearby objects in all directions, plus a flux of 20 foot candle light falling on the drawing board at 45° gives the best results;

(4) For mixing and matching colours, particularly pale tints, the light must be white and its strength strictly limited to 12 foot candles, and it may well fall vertically;

(5) For painting, fine needlework, and skilled work involving colour generally, the whiteness of the light is of the utmost importance, diffusion as for draughting is required, with a 12 foot candle illumination on the object at about 60°;

(6) In a machine shop the light falling on fine work may well be as high as 40 foot candles, but this will cause fatigue if general diffused illumination is not provided at a strength of say 12-15 foot candles;

(7) In a stone-cutting shed variation in strength of light is not a very serious matter. Direction, to give light and shade, is important; for form is not fully revealed in a diffused light.

It will thus be seen that **very moderate strengths** of light are required for the finer operations of industry and for full appreciation of objects displayed.

LIGHT FROM THE SKY

The source from which white daylight is obtainable is the more or less diffused light of the sky; not the direct light of the sun—that is to say, it can be got through windows or skylights with a Northerly exposure. Sky illumination varies throughout the day, and throughout the year, according to latitude. Even on the shortest day of the year, at the latitude of the Canada-U.S.A. border, one can rely on a total sky illumination of about 300 foot candles at 8 a.m. and 4 p.m. (unless there is a heavy snowstorm). By midday on the shortest day, 800 foot candles is usually available from the sky alone. On the longest day in that latitude, the midday sky illumination will be about 1800 foot candles, and at 4.30 a.m. and 7.30 p.m. it will equal the shortest day sky illumination of 8 a.m. and 4 p.m.

It will thus be seen that by designing apertures to provide good working light for working hours towards the ends of the winter day and then furnishing closing devices, this valuable white light can be maintained close to the required working strength throughout the day and the year.

It is obvious that only limited working planes, whether vertical or horizontal, can be directly illuminated with North light. But the area of these working planes can be doubled by the use of modern reflecting media suitably disposed.

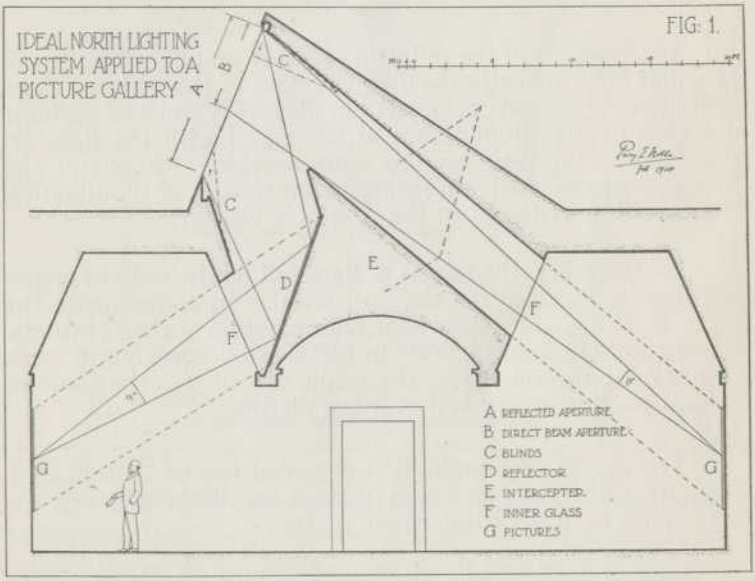
The system about to be described enables one to take white light from the Northern sky and to deliver it as **working light of approximately constant strength** and over **working planes of double the area** otherwise attainable.

The value of this system of lighting for picture galleries, museums, studios, workshops and laboratories can best be explained by giving some examples of its application.

A PICTURE GALLERY

There are cases of the picture gallery problem where other systems already in common use must be resorted to. This system demands that the gallery runs about East and West, so that one side faces approximately North, and that the sky to the North be unobstructed.

The first step is to provide a skylight aperture at a rake to exclude sunlight during working hours, and of such size that, with a given sky illumination (such as that at 4 p.m. on December 22nd at 45° of latitude), the solid angle of light reaching the wall below the skylight after reflection will give



the required illumination already defined. By contriving a suitable path for a direct beam of light from part of the skylight aperture to the wall opposite, such that the solid angle of light from this part of the skylight aperture also gives the required illumination on this wall, equal illumination on both walls is obtained. The length of the skylight being the same for both walls, the vertical components of the solid angles are measures of the light. By design and adjustment the difference in these angles must be made such that it represents the ratio of absorption due to the reflecting medium and other minor causes of asymmetry.

Blinds have next to be contrived within the skylight, to operate in such a way that the ratio of the whole skylight aperture for the reflected beam to the part of the skylight aperture for the direct beam remains constant as the aperture is reduced. This is a matter of gearing and control. The control may be entirely manual, or entirely automatic, or only partly automatic, depending on the nicety of adjustment of light required. The devices in this connection are described under the heading of "Blind Operation." If the sky illumination, on which the size of the total aperture is determined, was 300 foot candles, the midday 22nd June sky illumination at the same latitude may be as much as 1,800 foot candles, and well over 2,000 if white clouds are about. The blinds deal with these differences by closing over 5/6th of the aperture.

The position of the reflecting surface and its substructure provides for a shaded area over the floor of the gallery. The reflections of persons or objects in glass or varnished surfaces are thus of low illumination as compared with the light on the pictures and so become unnoticeable. Moreover, the picture surfaces receive no glares from sources of illumination that could be reflected to the eyes of a visitor.

Furthermore, the beams of light fall on the walls at angles between 30° and 40° to the horizontal. In consequence the pictures do not suffer from sharp illumination of their textures. Steep top light spoils colour in pictures by speckling it with points of light and shade, the result of which is the same as that of putting a grey veil over the picture.

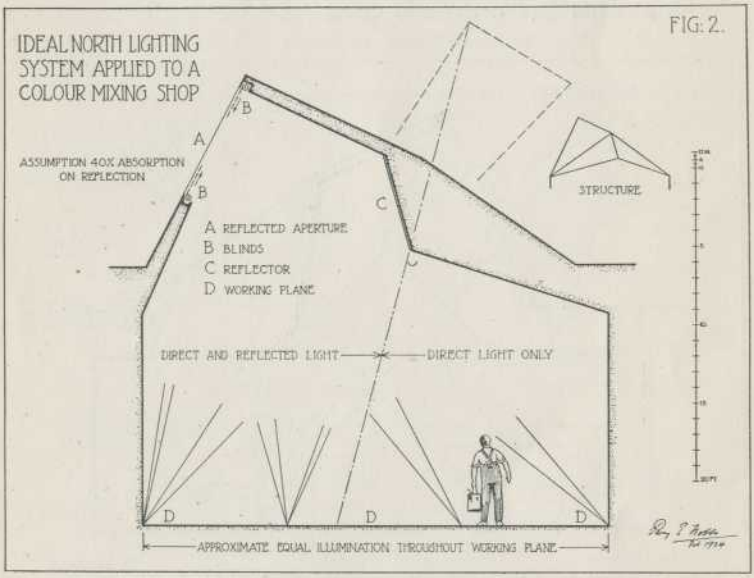
The degree of illumination obtained top to bottom over the part of the walls on which pictures are displayed is reasonably uniform, a very important matter.

This system, as applied to gallery lighting, has certain practical advantages. Since only a very moderate amount of exterior glazing, as compared with other systems, is required, there is economy in construction and maintenance and a greatly reduced heat loss.

In calculating the ratio of the angles of light to one another the factors are (a) the light absorption coefficients of light transmitting and reflecting media; (b) any differences of the angles of incidence of the beams on the walls. In a picture gallery it is equal horizontal illumination at corresponding points on both walls that is required.

A COLOUR MIXING SHOP

The illustration shows a colour mixing shop of indefinite length, East and West, provided with a North skylight throughout its length. It is here desired to give vertical lighting over as much of the floor area as possible. By appropriate setting out for the paths of the beams of direct



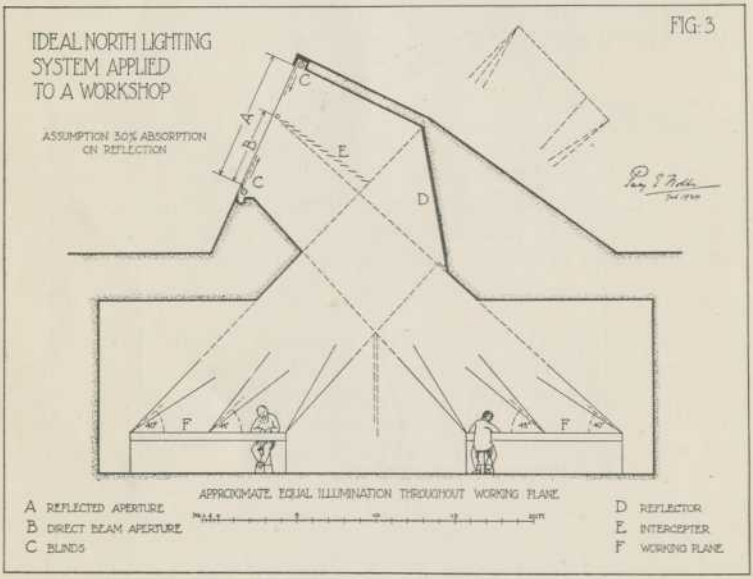
and reflected light towards all parts of the working plane (in this case the floor), half the floor receives an approximately uniform degree of illumination by direct beams, and the rest diminishingly; but the reflected beams compensate for this diminution, until the floor close to the North wall receives most of its light by reflection.

In this problem the direct and reflected beams are not separated; they intermingle to produce even distribution of light.

Blinds are used to ensure that the light already uniform over the floor should be maintained at constant strength during working hours.

A WORKSHOP

The illustration shows a shop suitable for embroidery, silverwork, or any fine trade. It would make a good draughting room and an excellent laboratory for scientific purposes. The aim in this case is to get the beam at about 45°. The source is the North sky, and the blinds control any surplus above what is required to give desired illumination on the working plane (tables in this case).



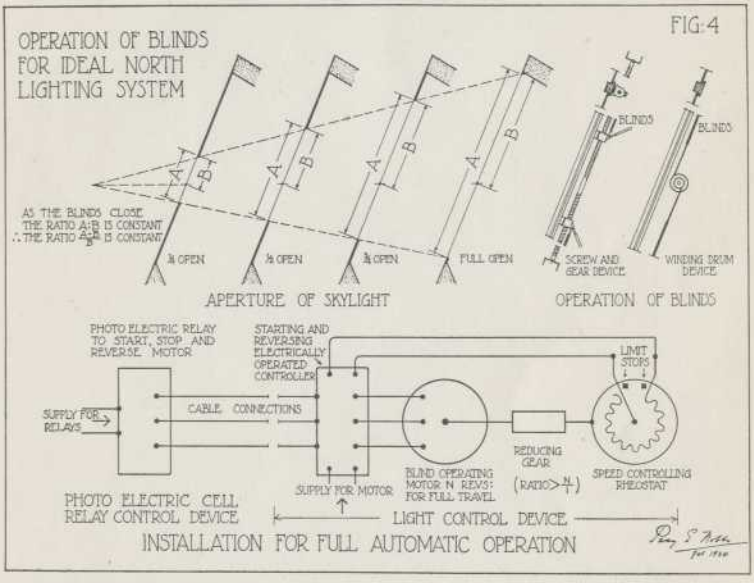
It will be observed that here the part of the skylight giving direct illumination is at the bottom and an interceptor is required of a different kind from that used in the case of the picture gallery, where the working planes were the walls and the reflector itself could be so placed as to intercept a part of the light from the aperture not required for the direct beam.

The central area between the work tables may be allowed to receive a mixture of direct and reflected light, or, by the erection of a central obstruction, which might serve many useful purposes, this area may be left to receive only general diffused light.

OPERATION OF THE BLINDS

The illustration shows the range of movement of the blinds and the devices required in this connection. The blinds themselves may be rigid or roller, and in the latter case certain kinds of slats may be substituted for fabric. Louvred blinds are not appropriate.

The immediate operation of the blinds may be by geared screws, or by cords attached to winding drums; in either case a motor may take the place of manual operation.



A completely automatic operation of the blinds can be obtained by the use of photo-electric cells installed at the working planes, to start and stop the motor of the light control device, either way.

In some cases, speed regulation may be important, as in a picture gallery. A speed controlling rheostat may then be used to automatically adjust the speed of blind travel at all positions and so give a substantially constant rate of percentage of aperture diminution, or increase, at all parts of the control range. Thus the effects due to passing clouds can be neutralized, as well as those due to the slower changes of light towards and away from the midday intensity.