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PHOTOGRAPHIC TRANSILLUMINATION

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FIG.2.

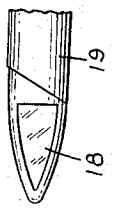
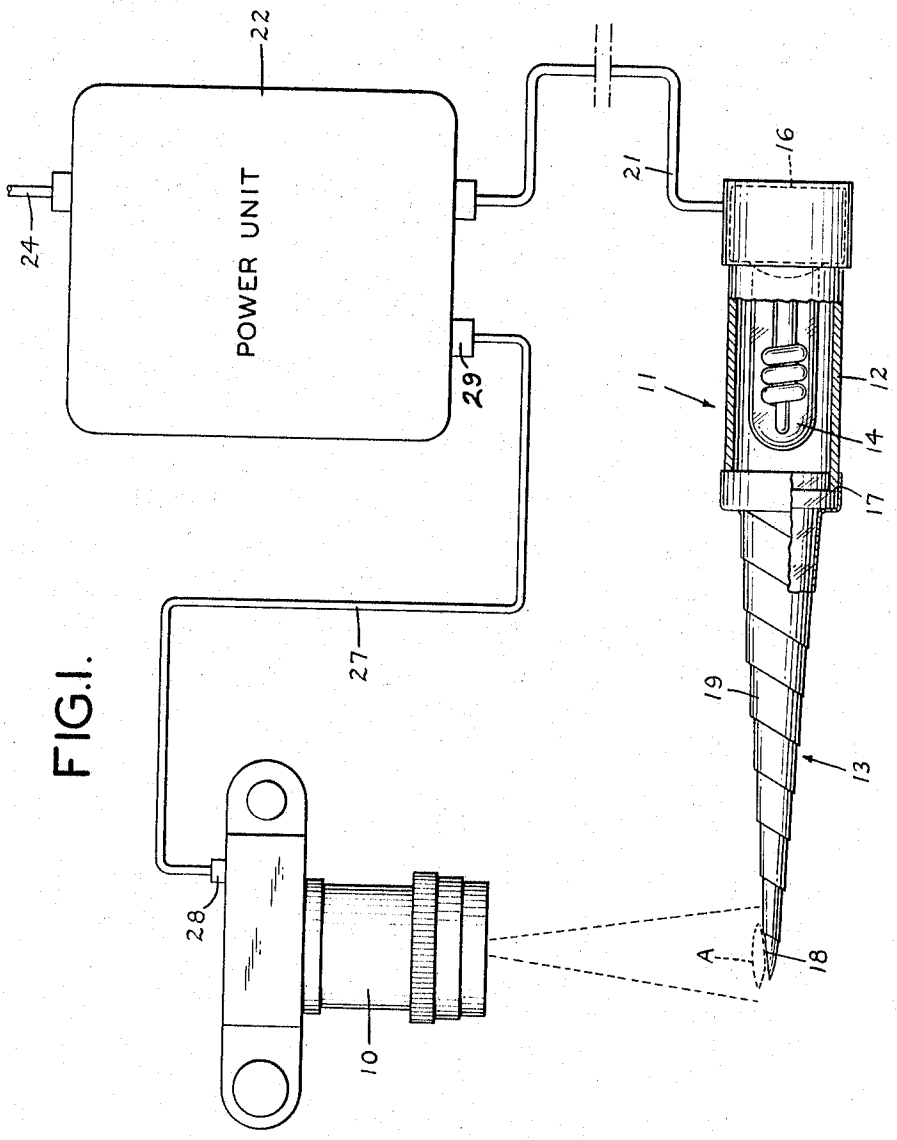


FIG.1.



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PHOTOGRAPHIC TRANSILLUMINATION

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This invention relates to photography and more specifically to transillumination of objects for photographic purposes. More particularly it relates to the transillumination of organic bodies and organisms for recording photographically the internal condition and details thereof.

In the medical and medical research fields it is often desired to photograph the internal portions of various organic bodies including organs and organisms of live animals and even humans. In many cases such photographs must be taken under surgical or operating conditions but must be accomplished without incision or other harmful cutting of the organic subject itself which must be able to fully function in the living body after the operation is complete. Quite often the organs yielding the more pertinent data in research work are the more sensitive and in size almost minute. For example, in cancer research it is common to photograph for analysis the surgically exposed bladder of a research animal to determine the influence of some experiment such as a chemical or drug administered to the animal. These photographs should be taken at an early or immediate stage of the research investigation of the animal and it is desirable to complete the operation required to expose the bladder so that the life of the animal may be extended as long as possible to determine the ultimate long term effect of the experiment.

This specific field of medical photography requires that the exposed organ or organism be transilluminated. This has been heretofore attempted by placing a light source behind and in contact with the organic object. Providing such transillumination under operating conditions without seriously damaging the subject has severely limited such photography which has been far from satisfactory. In order to transilluminate these organs it has been proposed to use a small, lower intensity light bulb placed under the organ and lit for a time sufficient to obtain the required exposure a photographic image. Despite the precaution taken the heat of contact between the organ and light source has been found to cause burning and trauma of the animal to the extent permanent injury is inflicted and life of the animal limited thereby which is contrary to the medical or research purpose. Also, the contact of the heated bulb with sensitive living matter causes abnormal or disruptive internal activity which may severely affect the accuracy of the picture. Moreover, the use of weakly lighting sources to minimize injury has had the disadvantage of limiting camera speeds and thus the sharpness and quality of the picture. Actually, exposure times were found severely limited to ½ to 3 seconds. In fact, the quality of the picture taken was so limited that much valuable information known to be available could not be developed by the photographs.

An object of the present invention is to provide new and improved method for transillumination of objects for photographic purposes.

Another object is to provide new and improved apparatus for transillumination of organic and living matter to be photographed.

Another object is to provided apparatus capable of transilluminating delicate live organism with high intensity light without causing injury or disruptive activity

A further object is to provide photographic means for obtaining accurate high quality photographs of the

internal condition of organic matter at high camera speeds.

Other objects and advantages will be evident from the following description of the invention and accompanying drawing in which:

FIG. 1 is combined elevational and diagrammatic view showing the photographic system of the invention including camera and co-operating transilluminator.

FIG. 2 is a fragmentary plan view showing in further detail a preferred supporting transilluminating platform provided by the transilluminator.

Referring to the drawings, FIG. 1 shows a preferred embodiment of the photographic apparatus of the invention as employed in recording the internal condition of a minute organ A which, for purposes of illustration only, may be the surgically exposed bladder of a small research animal (not shown). The organ or object A is positioned between the lens of the camera **10** and the light-emitting end of the transilluminator **11** on which the object is supported and transilluminated in co-operation with the camera.

The transilluminator **11** has a rigid housing **12** composed of a suitable heat dissipating and opaque material such as aluminum metal. The housing **12** is preferably cylindrical and has an opening at one end in which there is held a correspondingly shaped end of a light extender **13**. Housing **12** encloses a high intensity light source **14** which is desirably a stroboscopic electronic lamp. The light source **14** has base **16** which is rigidly secured and desirably centered within the housing. The light source **14** is adapted to emit high intensity light of which a substantial portion is directed longitudinally into the end of the light extender. It is particularly desirable to have the respectively adjacent ends of the extender and light source in close proximity so that the light immediately enters the extender without any substantial loss of intensity. For this purpose the extender **13** preferably has an annular shoulder **17** abutting in uniform supporting relation against the housing to control penetration of the correspondingly shaped end of the extender.

The light extender **13** is an elongated member especially adapted to deliver high intensity light a substantial distance from the light source **14**. The extender must therefore be composed of high light transmitting material through which a maximum amount of light can be passed with little or no loss of intensity. A particularly preferred material for high intensity light transmission is methyl methacrylate polymer resin which is well-known and commercially available from E. I. du Pont de Nemours & Company under the trademark "Lucite." The light extender **13** has at least a portion of its cross-sectional area decreasing in the direction away from the housing **12**. As shown, the extender member **13** is desirably tapered to form an elongated conical shape which aids in the concentration of high intensity light in the areas of smaller cross-section near the end portion of the extender. As shown in FIG. 2, the end of the extender has a platform **18** on which the object A is supported for transillumination. The platform **18** is slightly declined in a downward direction away from the light source so that as much light as possible is directed into the platform and object to be transilluminated. It is essential that at least the longitudinal half section of the extender member **13** which includes the platform **18** have its surface entirely covered with an opaque or light-blocking material to prevent extraneous light from reaching the camera lens and causing glare which destroys the value of the picture. Desirably, the light-blocking material **19** covers the entirety of the extender member **13** with exception of the platform, substantially as shown in FIG. 1. The light-blocking material may be any suitable opaque or reflective material capable of fully absorbing or reflecting light rays

which reach the outer surface of the extender. Ordinary electrcal friction tape has been found suitable for this purpose. An opaque plastic sheath having a small opening for a platform section is also well suited. The platform **18** is preferably made no more than aprpoximately equal to and is desirably slightly smaller than the object A to prevent light from the platform from directly striking the camera lens. As the size of the object to be photographed will vary it is evident that the effective lighting area of the platform may also vary. When the variations in size are large the entire extender **13** may be removed from the housing **14** and replaced by a similar fitting extender having a smaller or larger platform, as required. However, a relatively substantial degree of size variation may be tolerated by the same platform and such capacity may be greatly increased simply by blocking out a portion of the light-emitting area of the platform with an easily applied and removable light-blocking material such as friction tape. The use of a material such as ordniary friction tape on the platform as well as the extender therefore has the advantage of permitting the effective light-emitting area to be varied greatly both transversely and longitudinally without change of the extender.

The light-extender **13** may be made from the preferred methyl methacrylate polymer resin by machining from a cast rod of the material. The grained surface of the platform **18** resulting from machining is desirably smoothed or polished. The remaining portions of the machined extender may be also smoothed by buffing of similar means prior to covering with the light-blocking material.

The light source **14** is illuminated in synchronized cooperation with the camera **10** and receives an electronic charge through conducting means **21** which has one terminal connected to light source through the base **16** which is desirably integral with the light source. Conducting means **21** has its other end connected to a power well and control unit **22** which is adapted to supply the required electronic charge to the light source on signal from the camera. In order to achieve transillumination of organic bodies and obtain accurate photographs it is desirable to employ a light source of high intensity and preferably capable of supplying light at a strength in excess of about 1,000 peak candle power, most preferably a light source having strength capacity between about 3,000 to 10,000 peak candle power. The light source **14** is desirably an electronic vapor stroboscopic lamp operable at high voltage up to say about 900 volts. A suitable light source of high intensity may be obtained commercially from the American Speedlight Corporation as Model No. L420. This commercially available lamp has integral therewith an annular base which may serve as the base **16** and be readily inserted and retained within the housing **12**. Such lamp also has suitable conducting wires and connecting means suitable for meeting the requirements of the conducting means **21**. The power unit **22** includes a step-up transformer for converting low voltage electrical energy into high voltage electrical energy and a condenser which serves as a storage well for such high voltage energy. The power unit **22** has a conducting line **24** adapted to receive electrical energy from a community power source. The energy available from the community source may be sent directly to the step-up transformer or employed, as needed, for charging of batteries which may be included within the power unit **22** as a self-contained supply of the low voltage energy. The inclusion of the power supply within the power unit of course has the advantage of providing greater mobility for the photographic apparatus of the invention. A particularly suitable power unit **22** containing a 6 volt nickel-cadmium wet cell battery and vibrator to convert the direct current of the battery to alternating current along with step-up transformer and condenser may be obtained commercially from the American Speedlight Corporation, Model A405. Such unit is capable of advancing the 6 volts of the battery or 115 volts of the community power source to a high voltage up to 900 volts or even more to obtain the high intensity stroboscopic light for transillumination and accurate recording of the internal condition of organic subjects placed on the platform **18** of the extender **13**. A synchronizing cord **27** has a lead end **28** at one end connected to the camera **10** in co-operating relation with the camera shutter and actuating means (not shown). The opposite end **29** of the synchronizing cord is secured to the power unit **22** and connected in actuating relation to the condenser of such power unit **22**.

In practice of the invention, the object A is positioned on the platform **18** of the extender and preferably in such a manner that the object covers the entirety of the light-emitting portion of the platform. As the object A may be a minute organ the light-emitting platform is typically of a small area of about 0.1–0.4 cm.^{2}, it being an object of the invention to fully transilluminate such minute objects with concentrated, high intensity light emitting from a surface of such limited size. The object A is then focused by camera **10** which is positioned above the horizontal plane of the platform, usually in a position more or less vertically above the platform. The camera **10** may be any suitable photographic instrument such as a reflex camera. After placing the camera **10** in position the photograph of the object A may be readily obtained by operation of the camera actuating means which simultaneously opens the camera shutter and "shorts" together the leads of synchronizing cord **27** at the lead end **28** to send a signal through the synchronizing cord. The signal received by the power unit effects release of a high voltage electronic impulse from the condenser which is the power well within the power unit **22**. The electronic impulse passes through the conducting means **21** and causes illumination of the vapor of the high intensity light source **14**.

The high intensity light rays emitted by the light source **14** enter the extender **13** without any substantial loss of intensity due to the close proximity of the light source to the end of the extender. These rays travel through the extender and are emitted from the platform **18** where they transilluminate the object A while the camera shutter is open. At the area of emission from the platform the light has the desired high intensity due to the high light transmitting capacity of the extender and concentration effected by tapering of the extender body. The actuation of the camera and opening of the shutter are substantially simultaneous with the emission of the high intensity light from the platform and transillumination of the object A. Thus, time lag is negligible and synchronization of camera and transilluminating extender may be readily accomplished by adjustment of the camera actuating means so that the electronic circuit is closed or actuated at the time when the shutter is fully open. Duration of exposure is determined by the duration of the light which as supplied by the stroboscopic lamp employed in the apparatus of the invention is very rapid or of the order of less than $\frac{1}{100}$ second, more usually between about $\frac{1}{400}$ to $\frac{1}{2500}$ second. Shutter speeds are therefore of less importance and accurate photographs of the internal condition of organic bodies at any given instant, a very desired objective in medical research, may be obtained by the transillumination of such objects with the large amounts of high intensity light supplied during such rapid exposures.

Although certain preferred embodiments of the invention have been disclosed for purpose of illustration, it will be evident that various changes and modifications may be made therein without departing from the scope and spirit of the invention.

We claim:

1. Apparatus especially adapted for photographing the internal condition of organic bodies comprising, in combination with a camera; an elongated tapered solid homogeneous body of high light transmitting methyl meth-

acrylate resin terminating substantially in a point, a small platform substantially at said end point inclined longitudinally in the direction of taper and declined downwardly with respect thereto, substantially the entire surface of said tapered body covered with a light-blocking material leaving essentially only the platform uncovered, a source of high intensity light having a strength capacity in excess of 1,000 peak candle power and positioned closely adjacent the opposite end of said body, a housing of light-blocking and heat-dissipating material enclosing and securing said light source, means detachably securing the last-mentioned end of said body to said housing adjacent said light source, current conducting means having one end connected to the high intensity light source, an electronic power source connected to the other end of said current conducting means and adapted to supply current at high voltage to actuate said light source, said power source comprising a source of low voltage and means to step-up said voltage to a high level, and synchronizing means connecting said power source and camera to release current from said power source in cooperation with the camera actuating means whereby the light source is energized and high intensity light caused to emit from said platform while the camera shutter is open.

2. The apparatus of claim **1** in which the light source is a stroboscopic light source having a strength capacity between 3,000 to 10,000 peak candle power.

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