

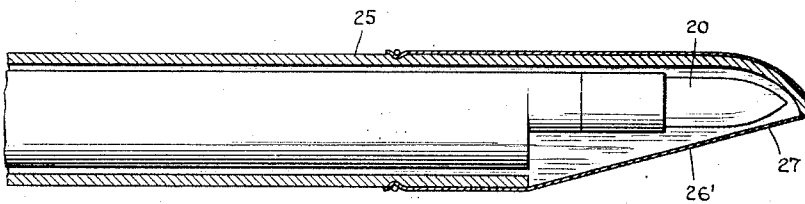
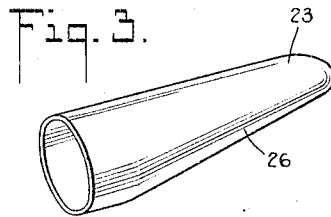
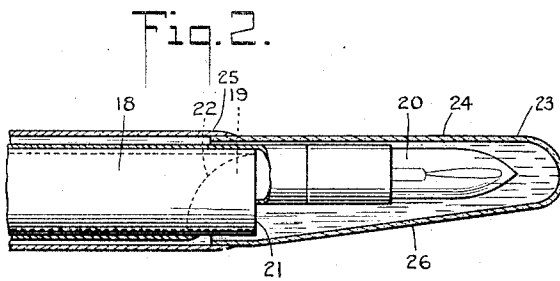
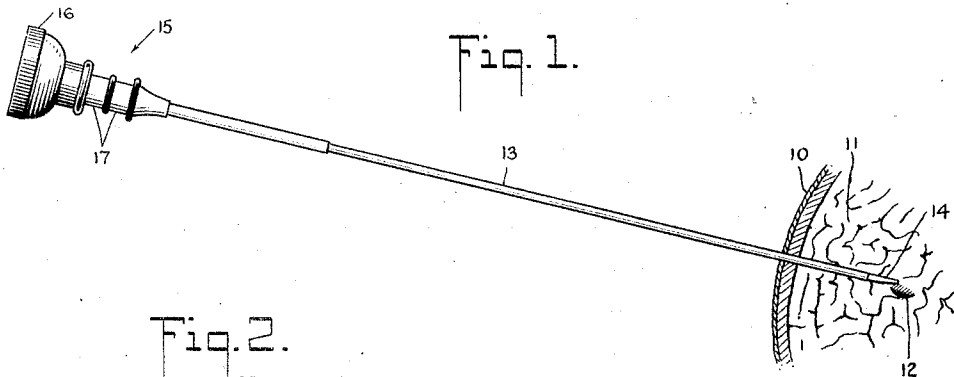
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R. H. WAPPLER

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ILLUMINATING PROBE DEVICE

Filed Dec. 8, 1926



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REINHOLD H. WAPPLER, OF YONKERS, NEW YORK.

ILLUMINATING PROBE DEVICE.

Application filed December 8, 1926. Serial No. 153,264.

My present invention relates generally to surgical instruments, and has particular reference to a surgical examining telescope.

One object of the invention is to provide a device which may be employed for the visual examination of solid material, the term "solid" being here used in a broad sense and being meant to distinguish from cavities into which an instrument may be inserted. More particularly, it is an object of the invention to provide a device for visual examination of such portions of the body as, for example, the brain.

Although my invention is designed primarily for a purpose of this character, nevertheless it may also be employed to great advantage in the examination of other inaccessible portions of the body which are not technically "solid", but which present similar problems. For example, my invention has been employed successfully in the examination of such inaccessible organs and portions of the body illustratively exemplified by the biliary ducts.

Before proceeding to describe my invention in detail, I will premise that examinations of the character contemplated by the present invention are beset with numerous obstacles of which the following are perhaps the greatest and at least illustrative.

In the first place, in the examination of such vital organs as those mentioned, and particularly in the case of the living heart, it is essential that vision be made possible in a direction forwardly of the instrument employed. Thus, in the treatment of mitral stegnosis, wherein a portion of the mitral valve is designed to be excised, the maximum length of time during which an instrumentality may be in operation within the heart is in the neighborhood of two minutes. Where the proper insertion and positioning of the instrument necessitates probing in the dark, the attempt to operate may often be unsuccessful.

In the second place, any instruments employed for examinations of the character mentioned must of necessity be exceptionally small from a cross-sectional standpoint. For example, in the employment of an instrument

for the examination of the biliary ducts, an overall diameter of about five millimeters is approximately the largest permissible size.

In the third place, where the material being examined is of a relatively solid character, exemplified by the soft and fatty brain structure, or where an opaque medium such as bile or blood is present in large quantities, means must in some way be provided for preventing the material or medium from crowding upon the objective and upon the illuminating means, otherwise observation would be entirely impossible.

In the fourth place, it is of course essential that the material or body portions being examined be properly illuminated by artificial means. The illumination must be such as to be effective in properly casting light upon the material within the field of vision; the illuminating means, preferably a miniature electric lamp, must be so positioned as to be itself out of the field of vision; and at the same time the requisite smallness of cross-section of the instrument must be achieved.

In the fifth place, an instrument of the character contemplated must embody more than means for forward vision, and must in fact be able to render visible the material or medium passed through during the movement of the instrument.

It is an object of the present invention to provide a device whose structural nature and operation are such as to solve the numerous problems exemplified hereinabove. More particularly, it is an object of the invention to provide a device which (a) permits not only forward vision but (b) vision other than forward during the movement of the instrument, (c) which provides for illumination of the material in the field of vision at all times, (d) which embodies the requisite smallness, and (e) which prevents crowding of the objective and the lamp.

In connection with the field of vision, it is an object of the invention to provide a device wherein a forward and sideward or so-called "foroblique" vision is rendered possible. In connection with the illuminating means, it is an object of the invention to provide such means in a manner and form which

illuminates the requisite field of vision efficiently without impairing, by its presence, the smallness and other advantageous features of the device. In connection with the requisite smallness, it is an object of the invention to provide a device whose cross-sectional area is no larger than the extremely small single tubes heretofore employed individually for either telescopic or illuminating purposes.

One feature of the invention lies in providing a device wherein a telescopic tube is provided with an objective commanding a substantially forward field of vision, in providing a lamp in such a manner as to cast its light along an axis traversing and substantially rectangular to the axis of the field, and in providing a window along a direction which might be said to form the hypotenuse of the figurative right angle referred to. Another feature of the invention lies in constructing the objective in such a manner as to command an obliquely forward or off-center field of vision, and in positioning the lamp in advance of the objective but out of the field of vision. In this connection, it is a feature of the invention to position the lamp within the calibre of the telescopic tube, and to construct the objective in such a manner that it will command a conical field of vision whose axis extends obliquely forward from the objective and whose inner limit skirts the lamp.

In other language, my invention contemplates an objective whose field of vision is defined by an axis extending forwardly at an acute angle to the axis of the telescopic tube, and a window disposed along a direction which traverses the field of vision at an acute angle to both the axis of the field of vision and the axis of the tube.

In the employment of a window of the character mentioned, it will be of course understood that the primary function thereof is to prevent crowding of the objective and of the lamp, but where the material exteriorly of the window is of an opaque character, the reflecting properties of the window present an added problem which must be solved. It is an object of the present invention to provide a window which is of such a character as to obviate the disadvantages of any reflecting properties. More particularly, it is a feature of my invention to provide the window in such a form, configuration, and disposition as to render the reflecting properties thereof negligible from the standpoint of the visible field.

It is a feature of the invention to provide the window in such a manner that a suitable liquid may be retained along the inside thereof so as to counteract in a predetermined manner any reflecting properties which may be present in the window.

In one form of the invention, the window is provided as a portion of a cap or sheath en-

closing the telescopic device referred to, the end portion of the sheath comprising an attenuated thimble or cap which meets with all the necessary requirements and which by its structure and arrangement in association with the other elements of the device effects the solving of the problems hereinbefore mentioned.

It is another feature of the invention to provide the window in a form which renders it adjustable. More particularly, it is a feature to provide the window in a manner which permits the window automatically to conform to the characteristics of the material exterior thereof. Thus, in one form of the invention, the window is provided in the form of a distendable sheet or diaphragm whose normal position and function is substantially like that of the cap usable in another form of the invention; it being contemplated that the distendable window may, when desired, be caused to distort or to adjust itself in a predetermined manner.

For the attainment of the foregoing objects and such other objects as may hereinafter appear or be pointed out, I have illustrated two forms of my invention in the accompanying drawings in which—

Fig. 1 is a side view of an examining telescope embodying the features of my invention, the telescope being shown in position within a skull in contemplation of a brain examination;

Fig. 2 is a cross-sectional side view, upon a greatly enlarged scale of the extreme end portion of the instrument shown in Fig. 1;

Fig. 3 is a perspective view of a thimble or cap embodying certain features of my invention; and

Fig. 4 is a view similar to Fig. 2 showing a modification.

In Fig. 1, I have illustratively shown an instrument of a character which has been successfully employed for the location of tumors in the brain. It is wellknown that the brain is a soft, fatty organ which may be probed indiscriminately and which is normally of a grayish color. By means of the instrument shown in Fig. 1, successful examining operations have been performed, wherein a small opening in the skull is produced under only local anæsthetic, and the instrument inserted therethrough to locate definitely, by direct visual illuminating means, the exact location, nature, and extent of the tumor. In this way, it will be noted that any necessity for removal of relatively large portions of the skull, or for probing "in the dark" with reliance upon only the sense of touch, is obviated.

Fig. 1 is merely illustrative of the general nature of my entire device. For example, I have illustratively shown a portion of a skull 10 beneath which is disposed the brain 11 and within which I have indicated roughly 130

a portion which may be assumed to be a tumor 12. The instrument comprises a relatively long tube 13 having an inner end 14 which will be presently described, and having an outer portion 15 which embodies the complementary accessories of the device. For example, I have shown an eyepiece 16 through which an operator may look, and I have illustratively shown two mutually insulated bands or collars 17 to which proper electrical connections may be made for completing the electrical circuits through the device and through the illuminating lamp. Where desired, the outer portion of the instrument may also embody such accessories as pet-cocks, valves, and the like in accordance with particular requirements. The device is in general approximately one foot in length and may have a diameter as small as five millimeters. It will be understood that extreme smallness in cross-sectional area is essential for operations of the character contemplated.

In Fig. 2, I have shown the interior end 14 upon a greatly enlarged scale, and it will be observed that I have provided a single tube 18 having an objective 19 in its outer end and having a lamp 20 associated therewith in advance of the objective 19. That portion of the present device which includes the telescopic tube, the objective, and the lamp, may advantageously be constructed and arranged in substantially the same manner as the device illustrated and described by me in my co-pending application #142,286, filed October 18, 1926.

It will be observed that the lamp 20 is positioned so as to constitute an extension which lies wholly within the calibre of the tube 18. This extension is smaller in cross-sectional area than that of the tube 18, and as a result a portion 21 of the objective is exposed. It is through this exposed portion that the light rays from the area viewed are designed to pass.

More particularly, it will be observed that the objective 19 comprises a plane front face of which the portion 21 constitutes a part, and that the inner surface 22 of the objective is disposed along a substantially spherical contour, the widest portion of the objective lying along the longitudinal line furthest from the lamp 20.

The objective 19 is arranged and constructed to command a field of vision which is substantially conical, the axis of the cone extending forwardly from the portion 21 and obliquely, at an acute angle, to the axis of the telescopic tube 18. The inner limit of the conical field of vision is made to skirt the lamp so that the latter will lie outside of the field of vision. It may be said that the objective 19 commands an off-center field of vision in advance of the objective.

In accordance with my invention I provide

an attenuated cap or thimble 23 whose smaller end encircles the tip of the lamp 20 and which flares outwardly toward the rear into ultimate substantial alignment with the periphery of the tube 18. In the form shown in Fig. 2, the cap 23 comprises a substantially conical element whose one side 24 constitutes a substantial continuation of one side of the telescopic tube 18, and whose other side is arranged at angle to the tube axis. The cap 23 may advantageously be made entirely of glass or similar transparent material, the inner end of the cap being cemented or suitably attached to the outer end of a sheath 25 enclosing the tube 18. The space between the sheath 25 and the tube 18 is extremely small and is designed solely for the passage therethrough of a liquid medium such as water. The cap 23 comprises a window portion 26, and it will be observed that this window portion traverses the field of vision. More particularly, it will be seen that the window portion 26 lies on one side of the objective and the lamp and extends forwardly from the objective so as to traverse the entire field of vision.

It will now be observed that whereas the axis of the field of vision may be said to be substantially forwardly, and whereas the axis of the light rays from the lamp may be said to be substantially transverse thereto, the window 26 is disposed along a direction which is angular with respect to both the field of vision axis and the light ray's axis. Stated otherwise, it will be observed that the window 26 is arranged along a direction which forms an acute angle not only to the tubular axis but also to the axis of the field of vision, and this arrangement of the window renders visible all the material lying exteriorly of the window. In this way, although the cross-sectional area of the entire device is exceptionally small, nevertheless a visible area of decidedly greater extent is provided for. Moreover, this visible area is one which is not only forwardly with respect to the objective and the instrument as a whole, but one which is arranged substantially longitudinally with respect to the instrument, so that whereas the instrument may be guided in its movement, the material passed through will at the same time be visible as the instrument moves. Furthermore, it will be observed that all these advantageous features are obtained without impairing the smallness of the calibre.

In Fig. 3 I have shown a perspective view of the cap employed in the instrument of Fig. 2, and although I have shown the window portion 26 arranged along a conical surface, nevertheless it will be understood that as to certain phases of my invention, such a configuration is not essential. For example, the window 26 may be made to lie along an absolute plane; but the cross-sectional

tional directional disposition will be substantially the same as shown in Fig. 2. It will be observed that the attenuation of the cap 23 obviates the undesirable reflecting qualities and characteristics of the window; yet as to certain phases of my invention, this attenuation is not essential.

In Fig. 4, I have illustrated a modification wherein the thimble or cap 23 has been replaced by a distendable diaphragm or sheet, preferably of such material as transparent rubber 27. In this embodiment, the portion of the sheath 25 nearest the lamp 20 is made to extend forwardly so as to provide a support for that portion of the sheet 27 not included within the window portion. Thus, it will be observed that the window portion 26 of Fig. 2 is here replaced by a window portion 26' which comprises a stretched portion of the rubber sheet 27 extending across the opening in the sheath 25 which the extension thereof has provided.

In this embodiment, the rear end of the entire instrument is designed to be associated in a suitable manner with a manually controllable bulb or the like (not shown) arranged and constructed to permit pressure to be exerted upon the interior of the window portion 26'. Where the bulb referred to is associated with the pet-cocks controlling the supply of liquid, manipulation of the bulb may be made to increase the pressure of the liquid within the sheath 25 and thereby cause the window portion 26' to distend slightly. In many applications of the invention, this feature may be extremely desirable, because the nature of the sheet 27 will permit the window portion 26' to conform automatically to the characteristics of the exterior material. For example, where undesired stones are searched for, the distension of the window portion 26' may assist the exact location of such unyielding objects.

Although I have shown the invention adapted for employment of a liquid such as water, nevertheless it will be understood that the employment of such a liquid is optional, serving in certain cases to minimize still further the reflecting properties of the window portion.

It will thus be seen that I have provided an instrument which will be of extreme benefit not only to the surgical profession but also to mankind in general. By means of my instrument, examinations, and operations may be performed which have been heretofore practically impossible, or performed only under extremely hazardous conditions and under the great disadvantages of practically blind probing.

The employment of the instrument shown in Fig. 1 for the purpose illustrated, permits an accurate location of the tumor 12. The operator sees the direction in which the in-

strument is being moved, and no blind probing is therefore necessary. As soon as he locates the approximate position of the tumor being sought, the movement of the instrument past this place will definitely locate not only the position but the extent and kind of tumor. The instrument has been successfully used for this purpose, and the operator has been able clearly to observe the beginning of the diseased tissue, the extent and quality thereof, and the passage of the instrument eventually into normal or healthy tissue beyond.

In the employment of my instrument for the treatment of diseases in the living heart, such as would require examination or operation of the valves, the forward vision permits the operator to insert the instrument accurately and without guesswork through the numerous passages and past the desired valvular openings in a minimum amount of time. Frequently, the end of the instrument may be provided with cutting instrumentalities which may at once be made to function and thereby permit the entire location and operation to be performed in less than a minute.

Heretofore, in the examination of the common bile duct, to determine the presence of stones, blind probing has been the only method employed. By my instrument such procedure is no longer necessary, and accurate examination may be obtained with great ease and facility. An instrument of the character illustrated, employed for this purpose assures the removal of every single stone or impurity that may exist in the place examined.

Where my invention is employed in portions embodying opaque fluid, such as bile or blood, the pressure of the window against the walls or other portions of the organ has been found to squeeze the blood or medium out of the way so as to render the fibrous structure of the walls clearly visible. Where the material examined is of a relatively solid nature, this pressure exists constantly, and consequently accurate examination of the parts passed through may be obtained.

Although I have illustrated and described my invention as embodied in surgical instruments, nevertheless it will be obvious that my invention may find wide usage in the commercial fields, as for example, in the examination of flour, sugar, grain, or other mediums which have heretofore been unexamenable except by exhaustive removal of the material itself.

It will be obvious that many changes in the details herein described and illustrated for the purpose of explaining the nature of my invention may be made by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is therefore intended

that these details be interpreted as illustrative, and not in a limiting sense.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is—

1. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command a field of vision whose axis extends obliquely forward from the tube end, a lamp in advance of the objective, and a window arranged on one side of the objective and lamp so as to traverse the field of vision, said window being arranged at an angle which is substantially the same in magnitude, but opposite in direction, with respect to the tube axis, as the angle of the field of vision axis.

2. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command an off-center field of vision ahead of said tube, a lamp in advance of the objective and within the calibre of the tube but out of said field, and a window arranged on one side of the objective and lamp and extending forwardly from said objective so as to traverse said field of vision.

3. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command a substantially conical field of vision ahead of the tube, a lamp associated with the tube end for illuminating said field, and a window arranged on one side of the objective and lamp and traversing the field of vision at a non-rectilinear angle to the axis thereof.

4. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command a substantially conical field of vision whose axis extends obliquely forward from the tube end, a lamp associated with the tube end for illuminating said field, and a window extending forwardly from the objective and arranged on one side of the latter and the lamp, said window being arranged to traverse the field of vision at an acute angle to the axis thereof.

5. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command a substantially conical field of vision whose axis extends obliquely forward from the tube end, a lamp associated with the tube end for illuminating said field, and a window extending forwardly from the objective, said window being arranged at an acute angle to both the tube axis and the field of vision axis and traversing the latter.

6. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command an off-center field of vision ahead of said tube, a lamp on said end in advance of the objective but alongside of said field, and a cap en-

closing said objective and lamp and provided with a transparent portion traversing the field of vision and arranged along a direction forming an acute angle with the tube axis.

7. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command an off-center field of vision ahead of said tube, a lamp on said end in advance of the objective but alongside of said field, and an attenuated cap enclosing said objective and lamp and comprising a transparent portion traversing the field of vision.

8. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command a substantially conical field of vision whose axis extends obliquely forward from the tube end, the inner limit of said field being substantially parallel to the tube axis, a lamp in advance of the objective within the calibre of the tube and positioned outside of said inner limit, and an attenuated cap enclosing the objective and the lamp, said cap having a transparent portion traversing the field of vision.

9. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command a substantially conical field of vision whose axis extends obliquely forward from the tube end, the inner limit of said field being substantially parallel to the tube axis, a lamp in advance of the objective and positioned outside of said inner limit, a tubular sheath for the tube, and a transparent cap at the end of the sheath, said cap being attenuated toward its outer end so as to provide a window forming an acute angle with both the field of vision axis and the tube axis.

10. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command an off-center field of vision ahead of said tube, a lamp on said end in advance of said objective but alongside of said field, and a distensible window arranged on one side of said objective and traversing the field of vision.

11. A device of the character described, comprising a telescopic tube, an objective associated with its end and adapted to command an off-center field of vision ahead of said tube, a lamp on said end in advance of said objective but alongside of said field, a sheath enclosing the tube and having an opening extending from the objective to the lamp tip, and a rubber window arranged and constructed to span said opening.

12. A device of the character described comprising a telescopic tube, said tube having at its end a lamp-accommodating extension of reduced cross-section but lying wholly within the space bounded by the extended peripheral surface of said end, an objective

in said end, said objective being constructed and arranged to render visible through the telescope a field of vision alongside of the extension and whose innermost limit lies
5 within said space, and a cap for said extension and objective, said cap having a window portion which traverses the field of vision.

13. A device of the character described comprising a telescopic tube, said tube having
10 at its end a lamp-accommodating extension of reduced cross-section but lying wholly within the space bounded by the extended peripheral surface of said end, an objective in said end adapted to render visible through
15 the telescope an obliquely forward field of vision sufficiently offset to exclude the lamp therefrom, said objective comprising a plano-convex lens whose plane surface is outermost and perpendicular to the line defining the in-
20 nermost limit of said field, and a cap enclosing said extension and objective and including a transparent window portion traversing the field of vision at an angle to said plane surface.

25 14. A device of the character described comprising a telescopic tube, said tube having at its end a lamp accommodating extension of reduced cross-section but lying wholly within the space bounded by the extended
30 peripheral surface of said end, an objective in said end, said objective being constructed and arranged to render visible through the telescope a substantially conical field of vision whose apex lies adjacent to the un-
35 covered portion of the objective and which extends obliquely forwardly from said apex in an offset manner which excludes the lamp therefrom, and a cap for said extension and objective, said cap including a window
40 portion traversing said conical field of vision.

15. An illuminating probe device of the character described for direct insertion into relatively solid matter for examination of the
45 latter, said device comprising an unbent tubular-element, a lamp associated with the end thereof in a manner which disposes the lamp wholly within the space bounded by the lateral surfaces of the tube, an objective in
50 said end and having an exposed portion thereof arranged to one side of the lamp, said objective being so constructed and arranged that its field of vision is obliquely forward of said exposed portion so as to exclude the
55 space bounded by the lamp, and a cap for said lamp and objective, said cap including a window portion traversing said field of vision.

In witness whereof, I have signed this specification this 26 day of November, 1926.

60 REINHOLD H. WAPPLER.