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A. L. BROWN

2,235,979

SURGICAL AND DIAGNOSTIC INSTRUMENT

Filed June 3, 1940

2 Sheets-Sheet 1

Fig. 2-

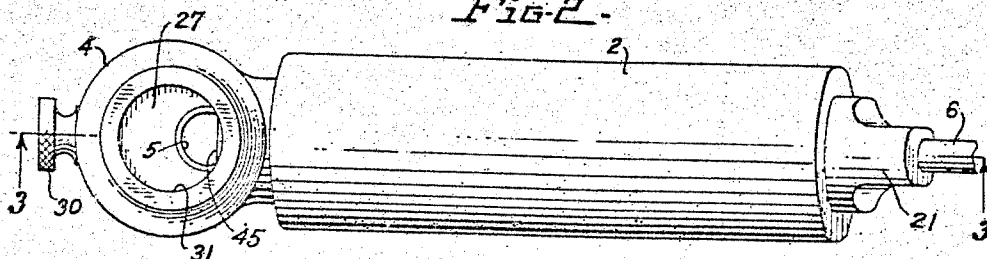


Fig. 3-

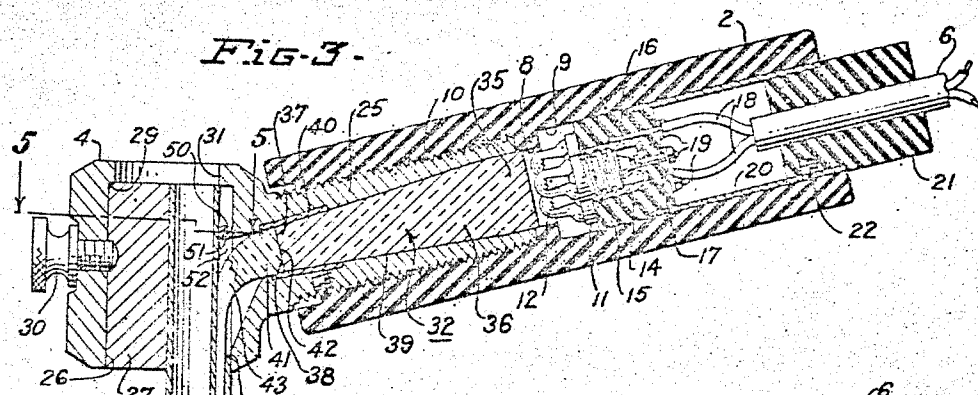
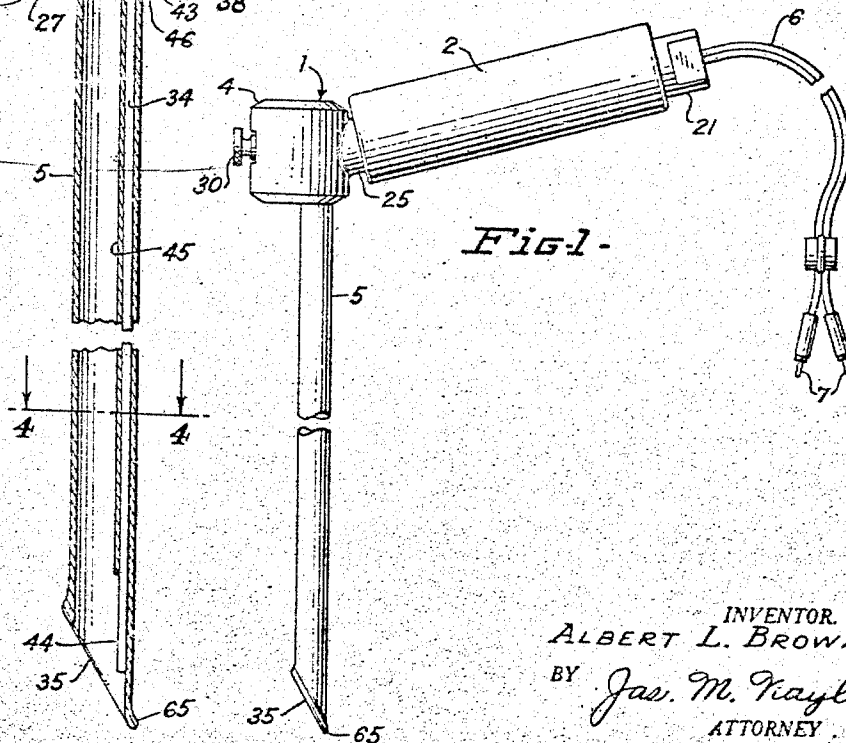


Fig. 1-



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Fig. 4-

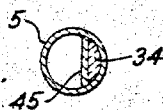


Fig. 5-

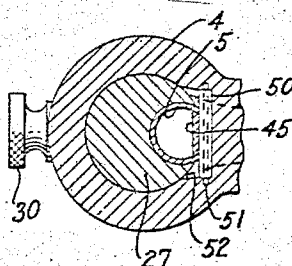
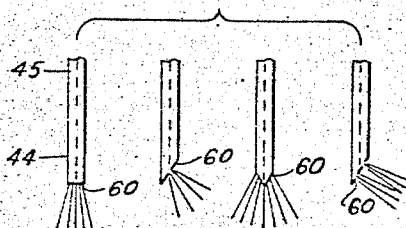


Fig. 6-



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SURGICAL AND DIAGNOSTIC INSTRUMENT

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3 Claims. (Cl. 128-6)

My invention relates to surgical and diagnostic instruments, and particularly to a device for use in inspecting and treating various bodily cavities.

A number of different instruments have been devised for the use of medical men in making internal examinations of various organs of the body. Some forms have involved very complicated systems of lenses and prisms in order to provide the proper focus and perspective in viewing the interior of the esophagus, the bronchial tubes, the excretory and the reproductive organs. The problem is complicated by the necessity for directing light onto the portion to be examined, without interfering with the observed image. Some examinations require a high intensity of illumination; others require great uniformity of light.

It is necessary not only to have a satisfactory instrument for examination, but it is desirable also to be able to use it in connection with surgical instruments, so that operations may be performed under adequate illumination and careful inspection.

This need has given rise to devices using hollow tubes which may be inserted into the bodily cavities through which the surgical instruments may be inserted. The limiting dimension on the design of such devices is the outside diameter which can be taken by the particular orifice with which each is to be used. Within this diameter space must be found for projecting light onto the particular area and reflecting back the image, and for the surgical instruments. An efficiency rating may be given such devices in terms of the ratio of the cross-sectional area available for passage and manipulation of the surgical instruments to the overall cross-sectional area occupied by the inserted tube.

Certain of these devices use very small light bulbs located at the end of the inserted tube. With these, difficulty is found in proper focusing and diffusing of the light for different uses, and the permissible bulb size make manufacture difficult and expensive.

Another type uses an external lens system to direct light down the hollow tube. The intensity can be accurately controlled at the source, but the light cannot be distributed in any desired direction at the inner end of the tube, and it is often necessary to illuminate for observation areas extending in a number of directions therefrom. This method is also objectionable in that the surgical instruments inserted in the tube cast a shadow and interfere with vision.

A more satisfactory type uses a round light-

carrying rod fixed in the tube, through which light may be directed from an external source. This design is inefficient, however, since it leaves so little of the tube area available for observation and the use of instruments.

A further objection to all of the previous designs has been the expense, since it has been necessary to have a separate instrument for each organ to be examined and treated.

The present invention overcomes the difficulties inherent in all such prior types of instruments. It comprises, in brief, a universal handle in which the source of illumination is placed, and to which different sizes and shapes of tubes may be connected for use with different organs of the body. A rod of material having a large critical refraction angle is used to carry the light from its source in the handle to the field to be illuminated. This rod is shaped to occupy a minimum of the cross-sectional area of the tube. The efficiency of the present design is from 61% to 73%, depending on the tube diameter, as opposed to about 52% for the best of the previous comparable designs. Due to the refractive characteristics of the rod material, the rod will carry the light through a curved path substantially without loss, and by proper shaping of the inner rod end, the light may be distributed in any desired way over the field of view. Thus any desired illumination may be obtained by using different light-carrying rods with any of the different tubes. Since the light is projected at the inner end of the tube, no shadows are cast by the surgical tools within the tube itself, and vision is under most favorable conditions. Since space requirements are not so limited in the handle, standard lens-type bulbs may be used.

The objects of the invention thus include providing an improved instrument for inspection, diagnosis, and surgical treatment of bodily cavities.

Providing more efficient utilization of the maximum cross-sectional area of such an instrument;

Illuminating interior surfaces of the body with any desired intensity and distribution of light;

Permitting inspection and treatment of interior surfaces without interfering shadows;

Utilizing a universal handle and illuminating unit with any desired number, size and shape of insertion tubes;

Reducing the cost of such instruments;

Providing an instrument with which more accurate diagnoses and more skillful operations may be performed by the medical profession, and

which can be quickly and conveniently disassembled for sterilization.

These and other objects will be apparent to those skilled in the art from the following description of detailed apparatus embodiments. These embodiments are exemplary of my invention, but are in no way to be construed as limitations thereof, as I contemplate the use of various modifications of my device within the scope of the appended claims.

For a more complete understanding of my invention, reference may be had to the drawings and to the following description in detail of the illustrated embodiments.

In the drawings:

Fig. 1 is a side view of my instrument;

Fig. 2 is a top view of the instrument shown in Fig. 1;

Fig. 3 is a side sectional view, taken in the plane 3—3 in Fig. 2;

Fig. 4 is a sectional view of a portion of my device, taken as indicated by line 4—4 of Fig. 3;

Fig. 5 is a fragmentary sectional view taken as indicated by line 5—5 of Fig. 3; and

Fig. 6 is a fragmentary view of alternative forms of light carrier tip.

Referring now to the drawings, in Fig. 1 I have shown my device, generally indicated by the numeral 1, as comprising a handle 2 into which is fitted a collar 4 holding a tube 5, and to which is attached an electrical connection cord 6 having suitable connection tips 7 for attachment to a controlled source of current, not shown.

Handle 2 is a tubular piece formed preferably of material such as a Bakelite. It is divided centrally by an annular shoulder 8 separating a smooth cylindrical light-source chamber 9 from a threaded bore 10. Into light source chamber 9 is inserted a lighting unit 11 using three small lens-type electric lamp bulbs 12. These bulbs are threadably inserted in sockets 14 fixed in a head 15 formed of insulating material such as Bakelite.

The sockets 14 are connected by means of side leads 16 and center leads 17 to the individual conductors 18 in cord 6. Conductors 18 may be attached to leads 15 and 16 by binding posts 19 or by any other convenient method, such as soldering. A sleeve 20 is attached to head 15, and is arranged to fit snugly within the light source chamber 9. A projecting handle portion 21 is attached by suitable means, such as a set-screw 22, to the sleeve 20 opposite lead 15. This handle portion 21 affords means for inserting and removing the lighting unit 11, as well as for anchoring cord 6.

The collar 4 is attached to handle 2 opposite handle portion 21, by screwing a threaded shank 25 formed integrally therewith into the threaded bore 10. Collar 4 is provided with a cylindrical bore 26, into which may be inserted a bushing 27 carrying the tube 5. An annular shoulder 29 extends into bore 26 to control the position of bushing 27, which is held removably by a thumbscrew 30 threadably disposed through the collar 4. Shoulder 29 defines a bore 31 through which the operator may look down tube 5. For convenience in use, I have found it desirable to form the bore 26 at an angle other than 90 degrees from the axis of handle 2, so that an obtuse angle extends between the handle 2 and the tube 5.

Light from the lens-type lamps 12 is focused on the area to be inspected by means of a light-

transmitting plug 32 disposed in the shank 25, and a light-transmitting rod 34 extending down tube 5 to the open end 35 thereof.

The light-transmitting plug 32 and rod 34 are formed of a material such as that known commercially by the trade-name "Lucite," an acrylic resin which possesses the property of passing light around corners substantially without loss. Any material possessing the similar optical characteristic of a large critical refraction angle, such as, for example, fused quartz, might be used with equal success.

Plug 32 comprises a large cylindrical end portion 35 which fits into the annular shoulder 8 within handle 2, a conical main body 36, and a small cylindrical end portion 37 having a planar end 38 normal to the plug axis. Shank 25 has a tapered bore 39 arranged to receive the main body portion 36, and is recessed near the small end portion 37 of plug 32 to receive a collar 40 fitting therearound and arranged to receive the large end 41 of the rod 34.

Rod 34 at its large end 41 is round and has a planar end 42, with its axis a continuation of the axis of plug 32. The rod changes its cross-sectional shape by gradual stages to become the segment of a circle in the rod portion 34. At the same time, it is curved in a rounded neck portion 43 so that its axis becomes parallel to that of the tube 5. Thus a beam light focused on the plug 32 by the lens-type lamps 12 is narrowed by the conical main body 36 of plug 32, carried around a curve by the neck portion 43 of the rod 34 and at the same time concentrated further so that the same quantity of light is available at the lower end 44 of rod 34 as is projected from the lamps 12, and may be properly directed onto the area to be illuminated by suitable facets formed on the rod itself.

Rod 34 is held against one side of tube 5 by a partition 45 which extends thereacross as a chord. The rod 34 makes a freely sliding fit between the tube 5 and the chord partition 45, while the tube 5 itself is cut away at 46 to allow the neck portion 43 of the rod to project.

The large rounded end 41 of the rod 34 is inserted first into the bore 26 of the collar 4 during assembly. When the round end 41 has been seated in the collar 40 with its planar end surface 42 adjacent and parallel to the planar end surface 38 of plug 32, the tube 5 may be slid upward about the rod 34 until bushing 27 rests firmly against shoulder 29 of the collar 4, where it may be held by thumbscrew 30. Stray light is prevented from passing out bore 31 by a gasket 50. Gasket 50 may be formed of rubber with a springy metallic core 51, which is set terminally into suitable recesses 52 formed in the wall of bore 26 overlying the rod 34, as shown in Fig. 5. Additionally, gasket 50 serves to protect the curved end 41 of rod 44 in the assembly of the device.

The lower end of tube 5 may be cut off at an acute angle to the tube axis, thus increasing the area which may be inspected through the tube. This also allows different light distribution patterns to be set up as desired. Different shapes of facets may be formed on the lower end of rod 34. For example, the rod shown in Fig. 3 will direct all of the light straight downward in a cylindrical beam. In Fig. 6, I have shown rod 34 having facets 60 shaped to distribute the light in various angles to the axis of the rod. These are exemplary only, as it will be obvious to those familiar with the art that a diffuse or concen-

trated beam may be obtained and directed as desired by the use of proper facet shapes.

The end 35 of tube 5 is preferably provided with a rounded peripheral bead 65. Bead 65 makes it easier to insert the tube into an orifice of the body without injury to the patient.

For certain uses, as in connection with the esophagus, it may be desirable to use a tube having an oval cross-section rather than a round section. In such case, I prefer to place the light-carrying rod near one of the foci of the oval portion.

In some cases it may be desirable to omit the cord 6, and to insert a battery, not shown, in the handle 2 to supply the bulbs 12. The lens-type bulbs used are ordinarily run at 2.3 volts, which may easily be supplied by a small dry cell. This adds portability, but is less flexible, since it does not as easily permit control of illumination intensity by a rheostat in the supply circuit, as is possible where the current is supplied through a cord 6 from an external source. Obviously the Bakelite handle provides good insulation of the portions of the instrument in contact with the patient from the electrical circuit.

Another modification includes provision for the removable attachment of an objective or lens above the upper end of the tube 5 to aid in examination. This is particularly suited for use in proctoscopy, where the lens may be attached in air-tight fashion to permit dilation of the organ by air pressure, as from a rubber bulb operated by hand. Further modifications in the instrument to meet special needs will be obvious to those skilled in the art.

Proper cleansing of the instrument as designed is easy. The handle which is of Bakelite, may be readily disinfected with the well known agents, as may the light-carrier plugs and rods of "Lucite." The tubes are of metal, and may be boiled. The lighting unit does not ordinarily need to be cleansed, as it does not come in contact with the patients. The plug rods, tubes and handle may be taken apart with great rapidity, which assists in maintaining the proper sanitary standards.

It will thus be seen that I have invented an instrument for the inspection and treatment of various bodily cavities which possesses numerous advantages. Obviously, it is not limited to use with human beings only. The efficiency in terms of available cross-sectional working area is substantially greater than in previous instruments, so that observation of the interior and manipulation of the surgical instruments is made easier. It is very flexible, since interchangeable tubes make possible a single instrument for use with all bodily cavities. Illumination may be accurately controlled, whether a highly concentrated or well-diffused light is required, and its intensity maintained at any desired point. The lens-type lamp bulbs used are commercially available at low cost and are of satisfactory quality. The instrument may be quickly and easily disassembled for cleansing and disinfecting. No difficult production methods are required, and this, together with the adaptability of the one instrument to a variety of uses, introduces substantial economy.

The invention claimed is:

1. In a surgical and diagnostic instrument, a handle having a cylindrical chamber and a threaded bore, a light source disposed in said chamber, a shank threadably inserted in said bore, a curvilinear light-transmitting plug disposed within said shank and adjacent said light source, a collar attached to said shank and a bore therein axially displaced from said handle by an obtuse angle, a bushing insertable in said bore, means for removably fixing said bushing therein, a tube fixedly associated with said bushing, a partition longitudinally extending through said tube, a curvilinear light-transmitting rod extending through said tube on one side of said partition and curving to enter said handle adjacent and optically continuous with said plug, a gasket disposed within said collar adjacent said curving rod portion, and a lens portion formed terminally on said rod opposite said curving portion.

2. The combination, in a device for inspecting and treating areas within bodily cavities, of a handle, a light source removably disposed therein, a bored shank threadably insertable in said handle, a bushing removably insertable in said shank, a tube fixed in and through said bushing, a division extending longitudinally of said tube, a rod formed of material having a large critical angle of refraction disposed in one divided portion of said tube, a curved expanded end terminating said rod and projecting into said handle, a plug disposed in said handle adjacent said expanded rod end formed of material similar to that of said rod, and means for preventing light spillage from said handle.

3. In a surgical and diagnostic instrument, a cylindrical handle, a shoulder annularly dividing said handle into a cylindrical chamber and a threaded cylindrical chamber; a light source comprising a cluster of lens-type lamps mounted in a Bakelite head, a cylindrical shell, and a handle portion attached to said shell and said head, an electrical connection cord passing through said handle portion and connected through said head to said lamps and having suitable external connection means applied to said cord, said light source being insertable as a unit in said cylindrical chamber; a threaded shank inserted in said threaded chamber, a conical bore formed in said shank, a cylindrically-ended conical plug disposed in said bore and projecting within the space defined by said annular shoulder, a tapered rod having a circular cross-section disposed adjacent said plug and curving axially away therefrom and tapering gradually to a cross-section constituting a segment of a circle, said rod and plug being formed of material having a large critical angle of refraction; a tube longitudinally compartmented fixed in a cylindrical element in turn disposed in said bore of said shank, with one of said compartments surrounding said rod, an angular end portion terminating said tube, a peripheral bead formed about said angularly terminated end portion, and lens facets formed on said rod adjacent said angular end termination.

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