June 10, 1952 R. R. ROSENBAUM 2,599,662

CHOLEDOCHOSCOPE

Filed Feb. 2, 1950 2 SHEETS—SHEET 1

Fig. 1

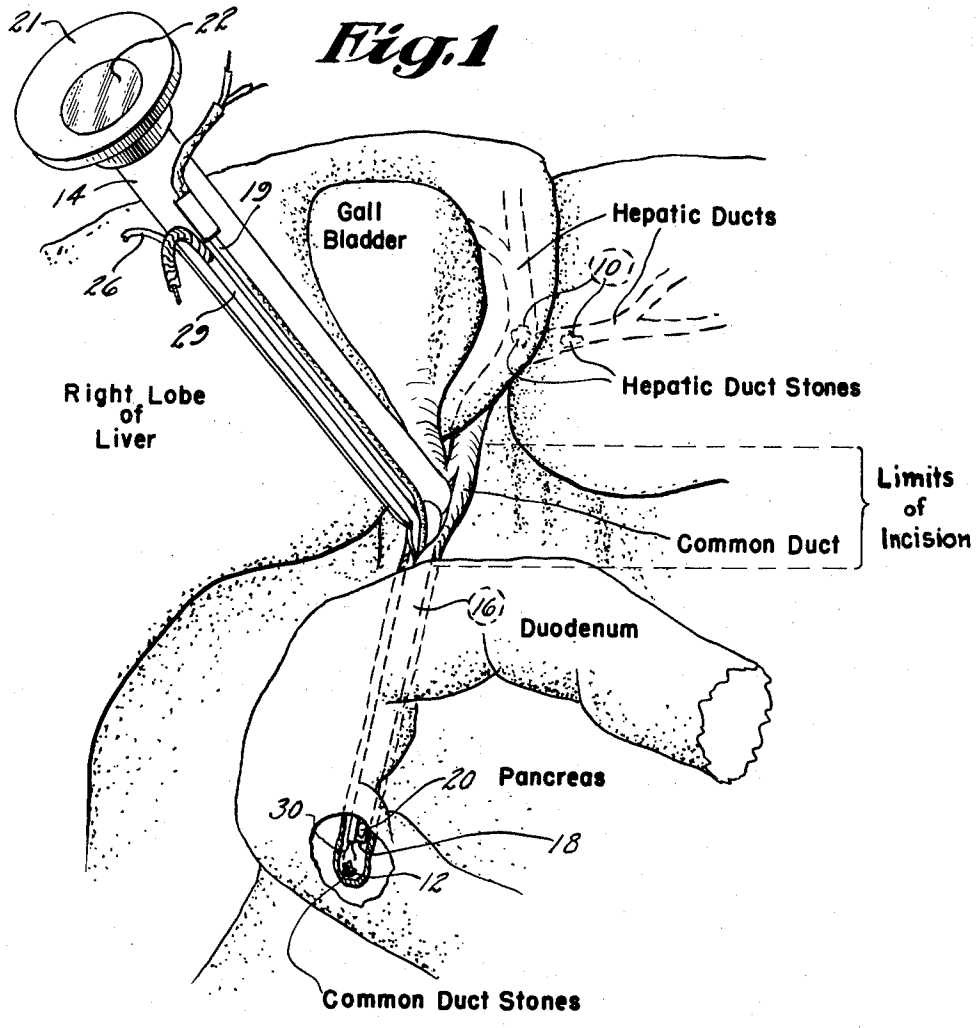
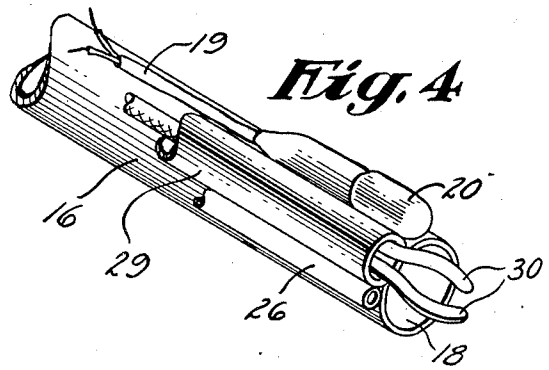


Fig. 4



INVENTOR.
Randolph R. Rosenbaum
BY
Harry Langsam
Attorney

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Filed Feb. 2, 1950 2 SHEETS—SHEET 2

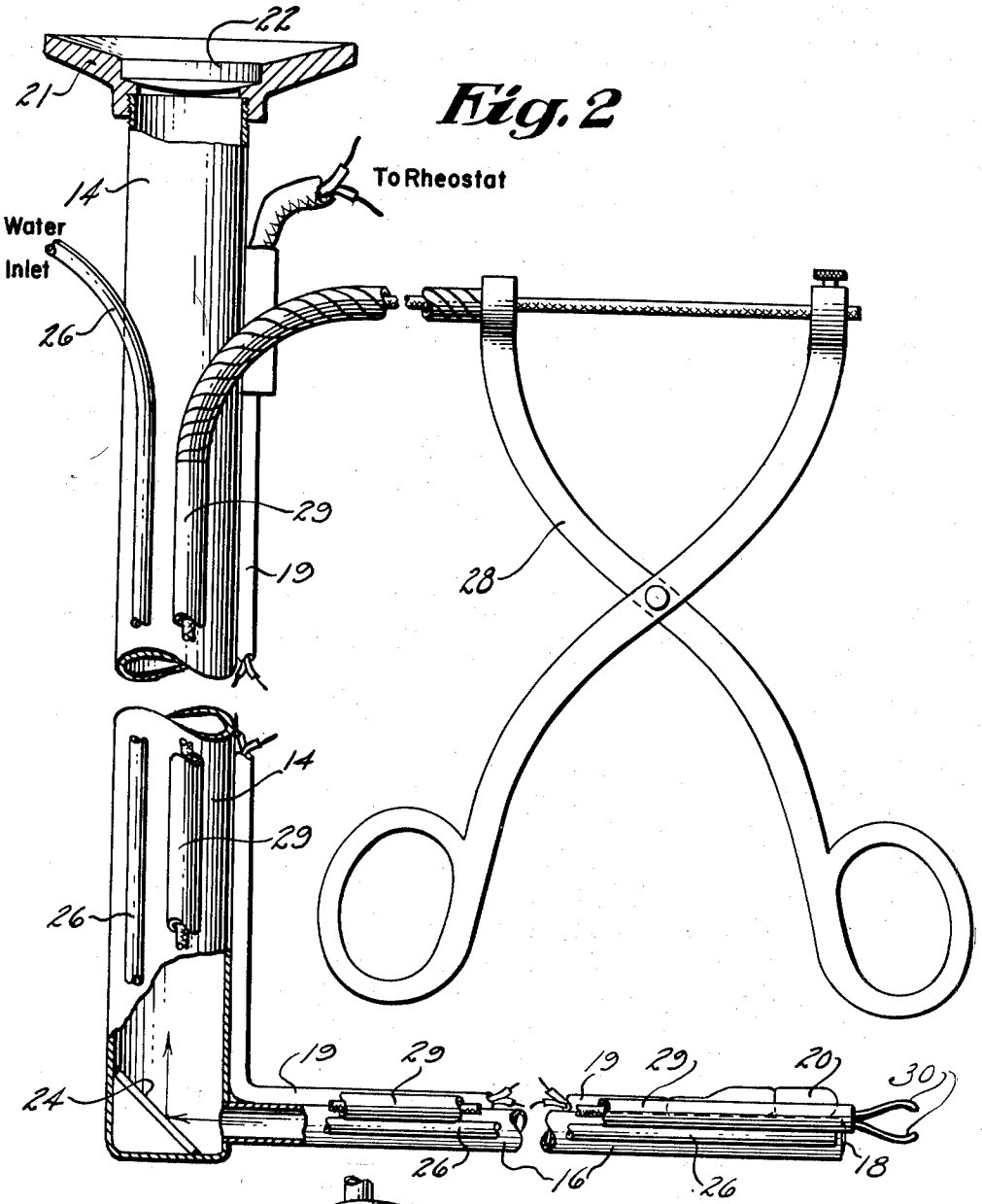

Fig. 2

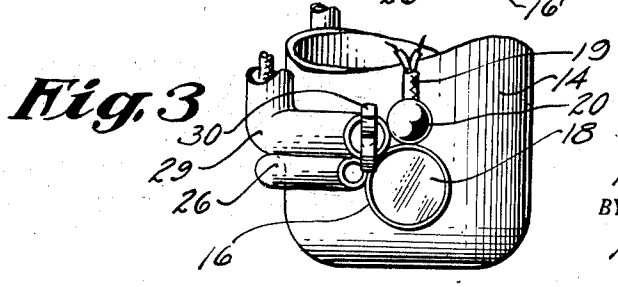

Fig. 3

INVENTOR.
Randolph R. Rosenbaum
BY
Harry Langsam
Attorney

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UNITED STATES PATENT OFFICE

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CHOLEDOCHOSCOPE

Randolph R. Rosenbaum, Philadelphia, Pa.

Application February 2, 1950, Serial No. 142,040

2 Claims. (Cl. 128—6)

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My invention relates to the examination of a distant portion of the human anatomy, and relates particularly to the examination and treatment of the bile ducts of the human body.

Heretofore, operations have been performed for the removal of undesirable obstructions, such as gall stones, particularly in the bile ducts of the human body. These operations with respect to seeing the undesirable obstructions have been blind since the surgeon can only feel his way about in the tiny ducts. Due to the fact that only a very small portion of the bile ducts may be safely exposed for the purpose of exploration and probing, operations performed under the conventional methods have resulted in removing between 80 and 90 per cent of the undesirable stones so that the normal operation leaves the patient with 10 to 20 per cent of the undesirable stones remaining in the hepatic duct, the cystic duct, or the common duct. Under some conditions, a second operation is necessary to remove the stones which have not been removed during the first operation.

No matter how careful the surgeon may be he is unable to see or feel his way around the small ducts where the biliary calculi (gall stones) may be located, so that he is dependent upon his judgement and experience.

Electro-acoustic devices have been proposed and made to detect and locate stones in the ducts, but these are expensive and inaccurate.

It is, therefore, an object of my invention to permit visualization of the inside of the common bile duct, hepatic duct, right and left hepatic ducts and some of the latter's branches.

Another object of my invention is to permit the finding and removal of biliary calculi (gall stones) in any of the above named ducts.

Another object of my invention is to permit the observation of the mucosa lining the ducts for the first time in vivo.

Another object of my invention is to permit accurate location of strictures in the ducts.

Another object of my invention is to permit observation, biopsy and treatment of benign and malignant lesions of the ducts.

Another object of my invention is to permit the visualization and study of the Sphincter of Oddi and its response to physiological and pathological stimuli.

Other objects of my invention are to provide an improved device of the character described, that is easily and economically produced, which is sturdy in construction, and which is highly effective in operation.

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With the above and related objects in view, my invention consists in the details of construction and combination of parts as will be more fully understood from the following description when read in conjunction with the accompanying drawing in which:

Fig. 1 is a view of the anatomy with my instrument in place.

Fig. 2 is a fragmentary side elevation of the choledochoscope embodying my invention.

Fig. 3 is a front view of the portion of the instrument inserted in the wound.

Fig. 4 is a perspective view of the tip of the instrument.

Referring now in detail to the drawing wherein my invention is shown, I show a human anatomy, wherein the gall bladder is shown, the right lobe of the liver is shown, the duodenum is shown, the pancreas is shown, the common duct is shown, the hepatic duct stones **10** are shown, and a number of duct stones **12** are shown.

The choledochoscope comprises a tube **14** which is joined at right angles to a smaller tube **16** having a diameter of approximately 3 mm. On the end of the tube **16** is a lens **18** which enables the viewer to see the interior of the ducts. At the lower end of the tube **14** is a mirror set at a 45 degree angle to reflect light upwardly. Adjacent the lens **18** is a small electric light **20**, which is connected to and controlled by a rheostat (not shown) by means of the sheathed wires **19**. This light illuminates the area in front of the lens **18**. At the upper end of the tube **14** is a lens **22**, inserted in a circular lens holder **21**, for the viewer to look through. Hence, the 45 degree mirror, or total reflecting prism, **24**, at the bottom of the tube **14** enables the image from the lens **18** to be reflected upwardly to the lens **22**. Thus the viewer can see the interior of the ducts.

Adjacent the tube **14** and the tube **16** extends a small water inlet tube **26** which is adapted to flush and wash away the substances in the duct.

Also adjacent the tube **14** and the tube **16** is a wire, encased in a tube **29**, which is attached to a flexible forceps handle **28** at one end and with a pair of fingers **30** extending beyond the lens **18**. Closure of the forceps **28** retracts the fingers **30** grasping any small objects near the lens **18**.

In application, the shorter arm **16** is passed into the ducts of the human body while the longer tube **14** presents the image up out of the depths of the wound to the viewer's eye. It is to be recalled that the duct often lies 5, 6, or even 7 inches below the level of the skin incision, depending upon the obesity of the patient.

Since the ducts can only be conveniently and safely opened into a relatively small area, as shown in the accompanying drawing, the choledochoscope is designed to be able to go down into the common duct in one direction, or withdrawn and inserted in a reverse direction to go up into the hepatic ducts. The length of the choledochoscope's lower arm permits complete examination of the ducts.

Although my invention has been described in considerable detail, such description is intended as being illustrative rather than limiting, since the invention may be variously embodied and the scope of the invention is to be determined as claimed.

I claim as my invention:

1. In a choledochoscope, a first tube having a lens at one end and a reflecting prism at the other end, a second tube joined to said first tube and having a lens on one end, a third tube adjacent said second tube for supplying water to a location near the lens on said second tube, an electric light adjacent the lens of said second tube to provide light for inspecting the interior of a wound, and a pair of flexible forceps adjacent to said second tube whose ends are adapted to grasp objects near the lens on said second tube.

2. A choledochoscope, comprising a first tube having a lens at one end and a reflecting prism at the other end, a second tube joined to said first tube adjacent said prism and having a lens at its free end, said first and second tubes being at substantial right angles to one another, a third tube adjacent said second tube for supplying water to a location near the lens on said second tube, an electric lamp adjacent the lens of said second tube to provide light for inspecting the interior of a wound, a pair of flexible forceps adjacent to said second tube whose ends are adapted to grasp objects near the lens on said second tube, and means for actuating said forceps being attached to and located exteriorly of said first tube.

RANDOLPH R. ROSENBAUM.

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