

[54] **INSUFFLATION APPARATUS FOR INTRODUCING LIMITED QUANTITIES OF CARBON DIOXIDE INTO THE HUMAN BODY FOR OPERATIVE PURPOSES**

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[51] **Int. Cl.** **A61b 17/00, F16r 17/34**

[58] **Field of Search**..... **128/303 R, 2 R, 2 A, 184, 128/341**

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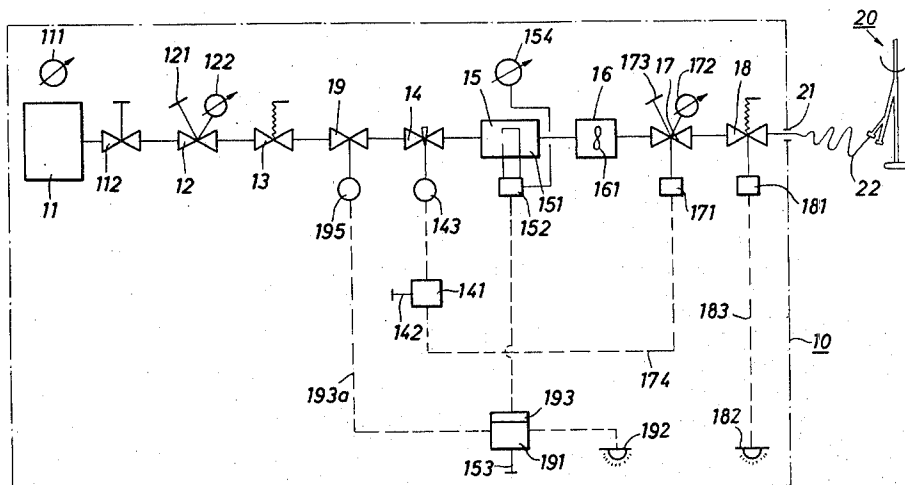
Fiber Optic Laparoscope-F08510 & 8530, 2-72
American Cystoscope Makers Inc.

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[57] **ABSTRACT**

The insufflation apparatus serves for introducing limited quantities of carbon dioxide into the human body for operative purposes and consists of a CO₂ container disposed in a housing and comprising a manometer and a shut-off valve and of an optical and/or acoustic signal device which is connected to a flow meter via a control device comprising a measured value comparator and a time switch, and the shut-off valve of the flow meter is connected to a device which reopens the closed shut-off valve after passage of a variable regeneration time and is controllable via the time switch.

3 Claims, 3 Drawing Figures



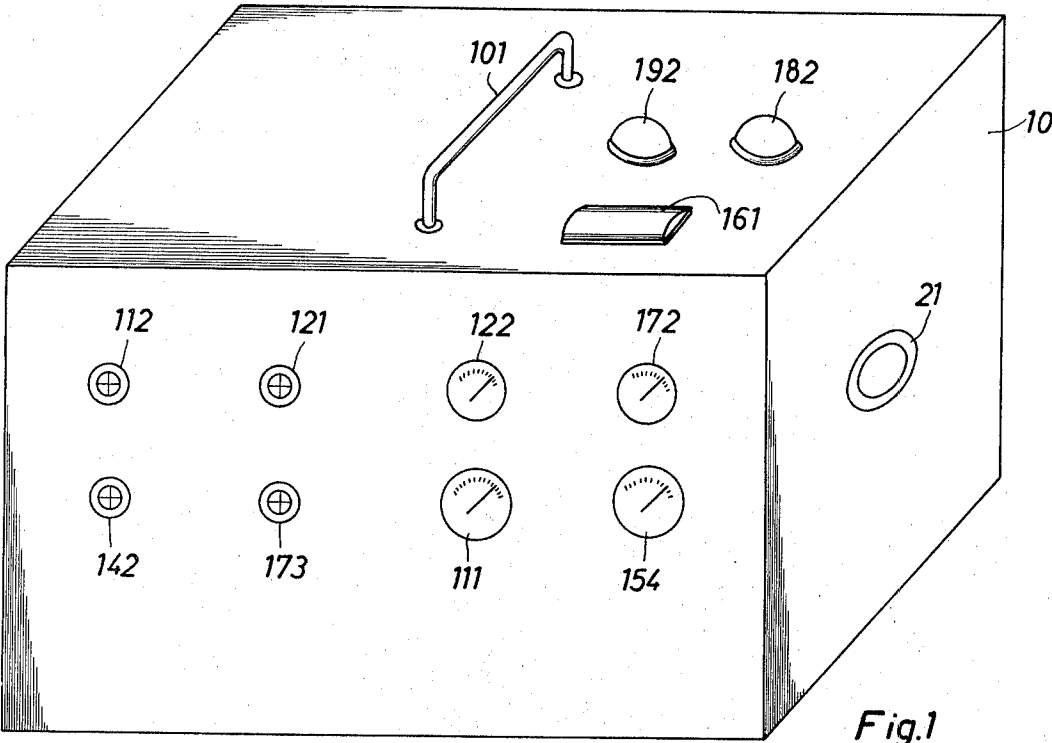
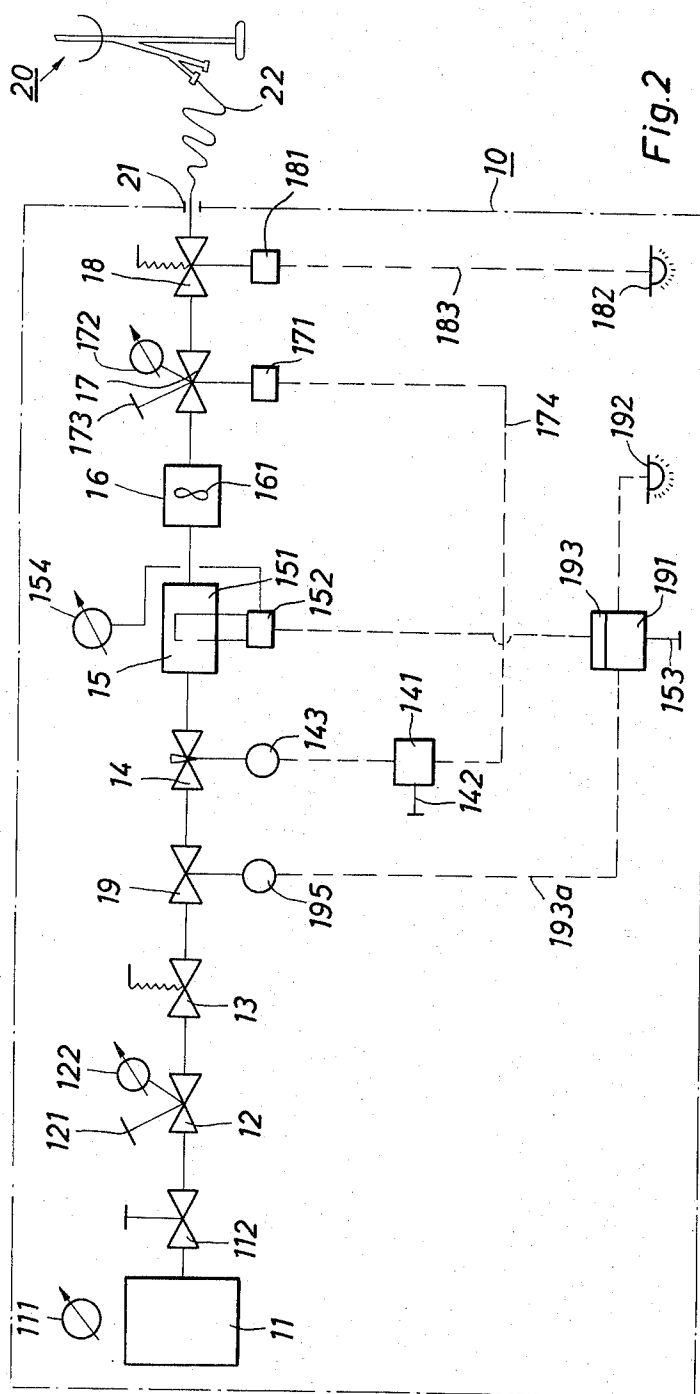


Fig.1



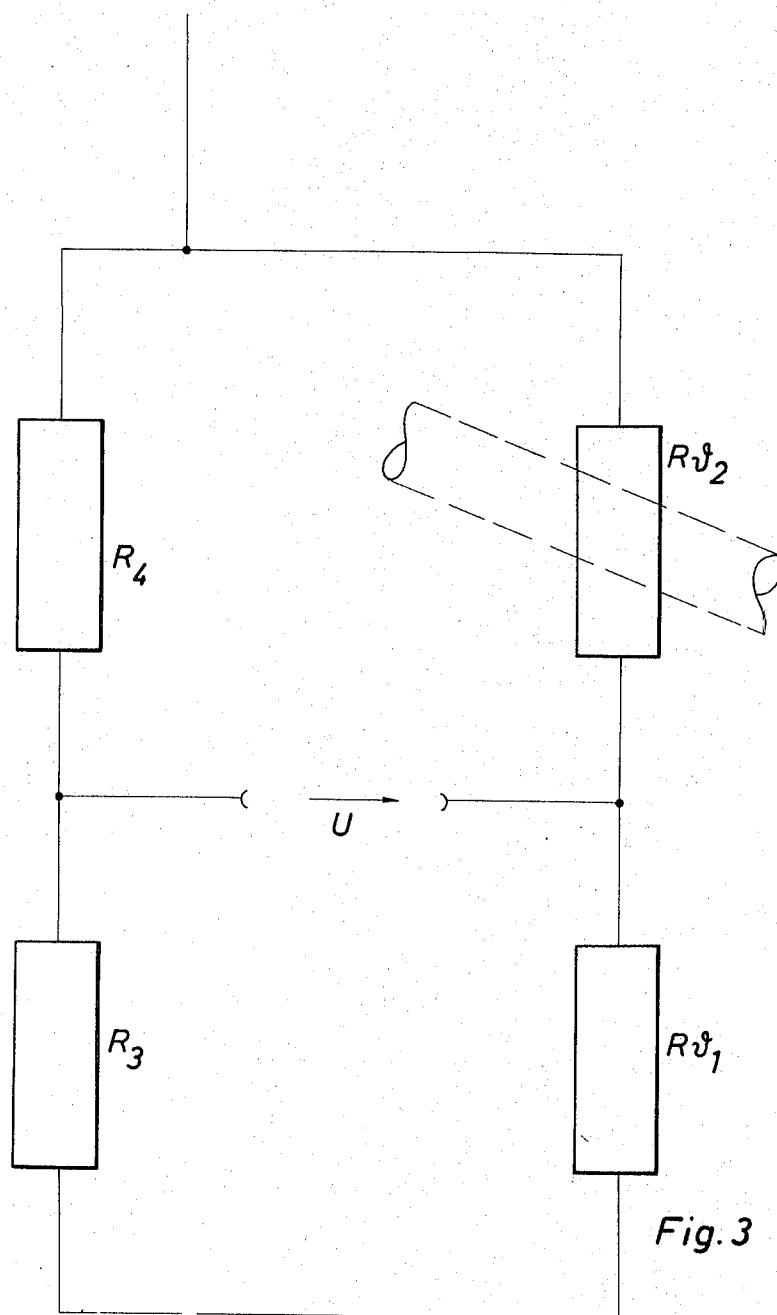


Fig. 3

INSUFFLATION APPARATUS FOR INTRODUCING LIMITED QUANTITIES OF CARBON DIOXIDE INTO THE HUMAN BODY FOR OPERATIVE PURPOSES

The invention relates to an insufflation apparatus for introducing limited quantities of carbon dioxide into the human body for operative purposes. To enlarge body cavities, in particular in laparoscopy and hysteroscopy, it is usual to insufflate carbon dioxide gas under low pressure into the human body, the cavum uteri being carefully expanded using a hysteroscope adapter. The amount of CO₂ which may be introduced into the body within a certain time is limited because CO₂ is absorbed by the blood and increases the natural carbonic acid present in venous blood due to muscular work. If under normal conditions more than about 200 mg CO₂ per minute is artificially introduced the dissolving power of the blood may be exceeded and gas bubbles may form in the main coronary vein, endangering the life of the patient.

The problem underlying the invention is to avoid the danger of a gas emboly when carrying out CO₂ insufflation into the human body and to offset the unstable temperature conditions arising from the expansion of the CO₂. The problem is solved according to the invention in that an insufflation apparatus for introducing a limited amount of carbon dioxide into the human body is proposed which is characterized in that a replaceable CO₂ container provided with a manometer and a shut-off valve, and an adjustable pressure regulator, a safety valve, a flow regulating valve, a flow meter, an optical flow indicator, an adjustable pressure limiting valve and a safety relief valve are disposed in a housing. The flow device is connected to an optical or acoustic signal device and to a shut-off valve via a regulator containing a measured value comparator and a time switch. When the shutting off is finished, the shut-off valve can be opened only after passage of a variable regeneration time.

The flow meter comprises PTC conductor feelers as measured value pick up means.

Since when carrying out insufflation the CO₂ passes into the body at definite temperatures, such as the room temperature of the operating theater, and the pressure and flowing gas volume are set, the amount of gas and number of gas molecules flowing to the body in unit time are also known.

An example of the invention is illustrated in the drawings, wherein

FIG. 1 shows the gas insufflation apparatus in perspective

FIG. 2 is a diagrammatic representation of the gas insufflation apparatus and

FIG. 3 is a wiring diagram.

The gas insufflation housing 10 is provided with a grip 101 and an adapter connection 21 for the hysteroscope 20 (FIG. 2). Disposed on one side wall are the operating means for the shut-off valve 112, the setting device 121, the manual desired value setting device 142 and the adjusting means or control element 173 with the associated optical indicating means 111, 122, 154 and 172. Arranged to be clearly visible on the top of the apparatus housing 10 are the optical or acoustic warning indicating means 182, 192 and the visible portion 161 of the optical flow indicator 16 which may consist for example of a small gas turbine. Disposed in the housing 10 is the replaceable CO₂ container 11 fol-

lowed in the flow direction by the shut-off valve 112, the adjustable initial pressure regulator 12, the safety valve 13, the shut-off valve 19, the flow control valve 14, the flow meter 15, the optical flow indicating device 16, the pressure limiter 17, the safety relief valve 18 and the adapter connection 21 inserted into the wall of the housing 10.

The pick up means of the flow meter is a high temperature conductor 151 consisting of a PTC resistor which is an electric resistor of n-conducting semiconductor material with positive temperature coefficients of electric conductivity, the material disposing of high conductivity when heating due to Joulean dissipation. A measuring bridge with two resistors R₃ and R₄ of the value R, and two PTC resistors R_{v1} and R_{v2} which should be alike are used. Current I₁ flows through the two PTC-resistors which are thus set to the same temperature level. When the environment is static, the measuring bridge is in equilibrium $U = 0$. The CO₂ which is to be measured passes by the PTC-resistor R_{v2}, whereas PTC resistor R_{v1} is in the static medium. The CO₂ flow passing by the PTC resistor R_{v2} heated with nearly constant power diminishes the heat conduction value of the PTC-resistor as against the environment, the temperature of the resistor falling in spite of constant energy supply. The resistance increases and the measuring bridge loses equilibrium $U \neq 0$. The PTC resistor R_{v1} is to make the measurement dependent on temperature and on pressure. The error occurring with the usual signal evaluation is, however, too big for medical needs and demands. Since the CO₂ expands, stable temperatures are never found. In order to make for this disadvantage, the signal is taken off a following electronic network. With this network a quotient is formed of the two impulses. In the formation of the quotient, the variables, temperature and pressure, which exert a negative influence on the measuring result, are eliminated so that

$$Q = i1/i2$$

is received. This quotient is a function of the temperature ($Q = A(T)$).

The PTC resistors 151 of the flow meter 15 are connected via a primary control element or pickup 152 to a controller 191 which contains a time switch and which comprises adjusting means or control element 153 for the desired value input and is connected by means of cable 193a to the warning indicator 192 and the positioning device 195 of the shut-off valve 19. The pickup 171 of the pressure limiter 17 is connected by means of the cable 174 to the controller 141 which contains a manual desired value setting device 142 and by which the flow regulating valve 14 may be actuated via the adjusting means 143. Disposed at the relief safety valve 18 is a pickup 181 which is connected via the lines 183 to the warning indicating means 182. The flexible hose 22 of the hysteroscope 20 is connected by means of an adapter to the connection 21 of the housing 10.

I claim:

1. In insufflation apparatus for introducing limited quantities of carbon dioxide into the human body for surgical purposes, said apparatus including a housing, a carbon dioxide container (11) disposed in said housing, a manometer and a shut-off valve (19) for said container, pressure regulating means (17), flow measuring means (15), a warning signal device (192), out-

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let means for connecting said apparatus to a hysteroscope (20), and flow path means extending between said carbon dioxide container and said outlet means, the improvement wherein said flow measuring means (15) includes a measured value pickup means (151) and is connected within said flow path means between said carbon dioxide container and said outlet means at a location upstream from said pressure regulating means taken in the direction of flow through said flow path means, and wherein said apparatus includes a control device (191) comprising a measured value com-

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parator (152), a time switch mechanism 193 and a nominal value setting device (153) which, together with said shut-off valve, are connected with said warning signal device.

2. Apparatus according to claim 1 wherein said warning signal device comprises means for generating an optical signal.

3. Apparatus according to claim 1 wherein said warning signal device comprises means for generating an acoustical signal.

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