

United States Patent

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[15] 3,674,010

[45] July 4, 1972

[54] APPARATUS FOR AUTOMATIC INFLATION OF CAVITIES OF THE BODY

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[22] Filed: July 15, 1970

[21] Appl. No.: 55,081

[52] U.S. Cl. 128/2 R, 128/4

[51] Int. Cl. A61b 1/00

[58] Field of Search 128/2 A, 2 B, 2 M, 2 R, 2 S, 128/2 W, 2.05 A, 2.05 M, 2.05 R, 4, 5, 6, 344

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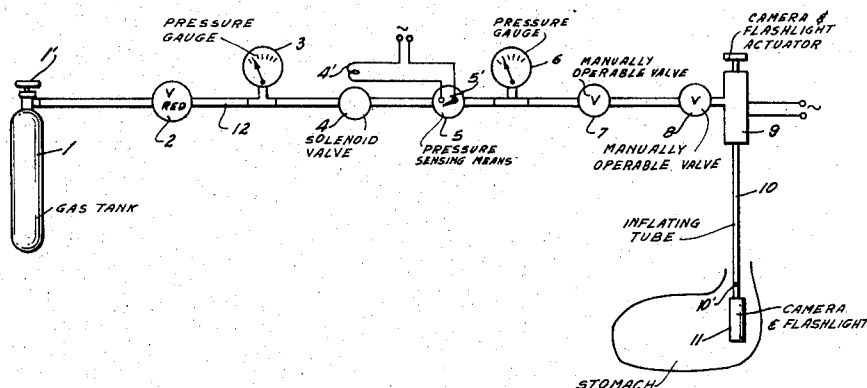
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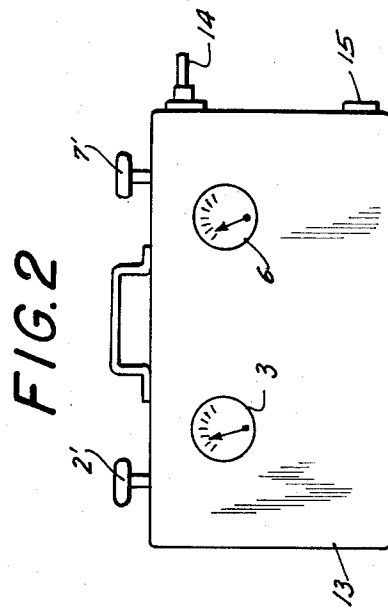
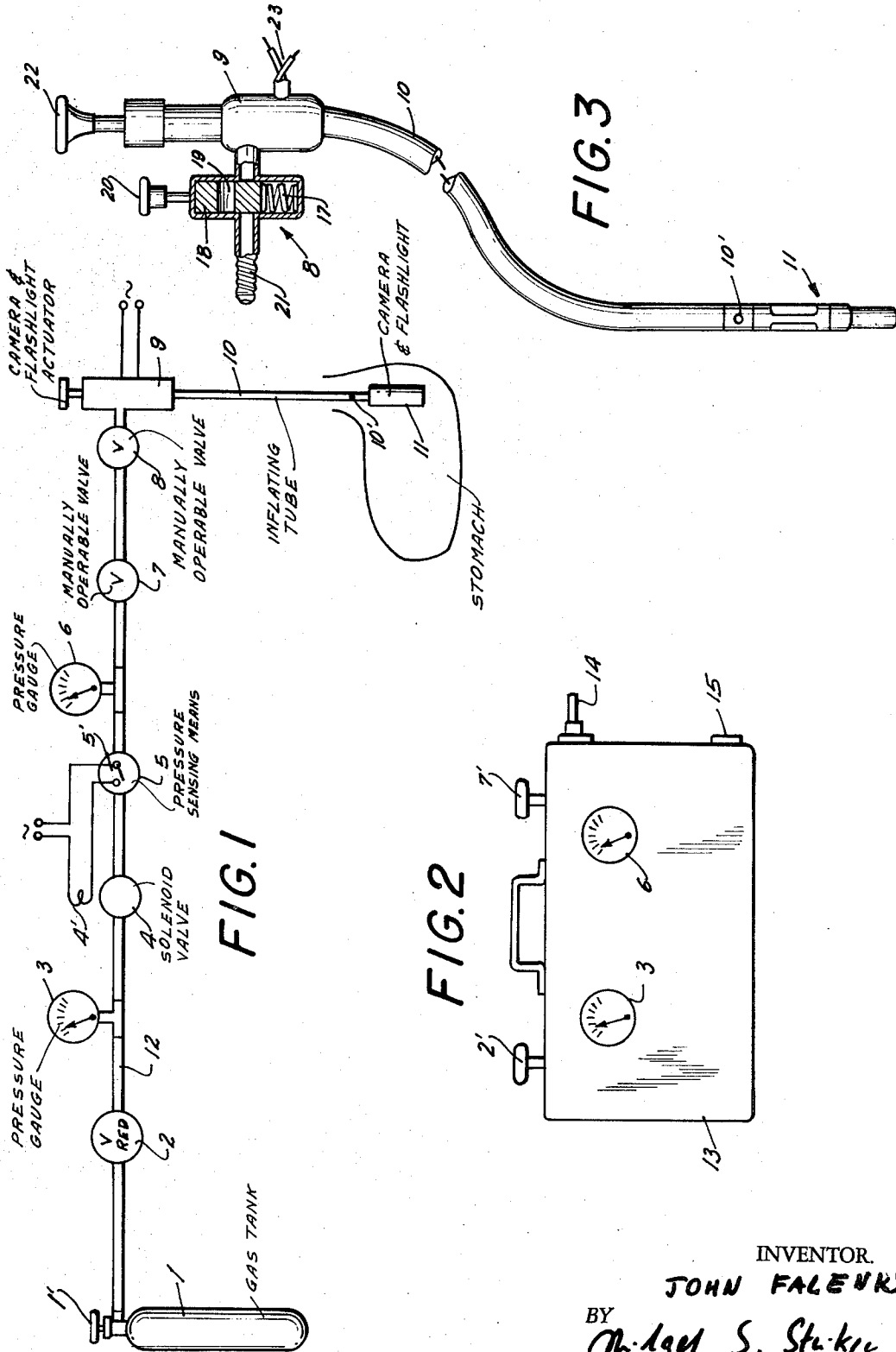
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ABSTRACT

Apparatus for automatic inflation of cavities of the body, for instance the stomach, in which an inflating tube insertable with one end portion into the stomach is connected by a tube to a tank containing a gas under pressure and wherein sensing means cooperate with the tube for sensing the gas pressure in the stomach and automatically shut off further passage of gas under pressure into the stomach when the gas pressure in the latter has reached a predetermined value. The end of the inflating tube which is inserted into the stomach preferably carries a camera and illuminating means so that the interior of the body, after being inflated, may be photographed.

10 Claims, 3 Drawing Figures





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APPARATUS FOR AUTOMATIC INFLATION OF CAVITIES OF THE BODY

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for automatic inflation of a cavity of the human body, for instance the stomach, by feeding a gas under pressure, for instance air, through an inflating tube inserted in the stomach into the latter, in which the inflating tube carries at its free end which is inserted into the stomach a special camera and illuminating means so that the interior of the stomach, after being inflated to a predetermined degree may be photographed.

Such an apparatus is known in the art and for instance disclosed in the U.S. Pat. No. 1,828,141, to Back, in which manually operated compressible rubber bulbs are connected to the inflating tube to pump during successive compression and release of one of the bulbs, air in the stomach through the aforementioned inflating tube.

This known apparatus has not only the disadvantage that the inflation of the stomach by successive compression of the rubber bulb takes considerable time, but also the further disadvantage that the degree of inflation of the stomach, that is, the air pressure produced therein, cannot be ascertained.

Furthermore, if the patient, whose stomach is inflated, belches before the pictures of the interior of his stomach are taken, the air thus escaping from the stomach, will not be automatically replaced, which may lead to the taking of unusable pictures since during taking of the pictures, the inner surface of the stomach wall has to be displaced a certain distance from the camera.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide for an apparatus of the aforementioned kind which overcomes the above-mentioned disadvantages of such apparatus known in the art.

It is a further object of the present invention to provide for an apparatus for automatic inflation of cavities of the body, such as the stomach of a patient, to a predetermined degree.

It is also an object of the present invention to provide for an apparatus of the aforementioned kind which is simple in construction so as to be produceable at reasonable cost and so as to work trouble-free during extended use.

Another object of the present invention is to provide for an apparatus in which the stomach may be inflated with a gas other than air.

It is yet a further object of the present invention to provide for an apparatus of the aforementioned kind which can be easily transported from place to place and in which the inflating tube and the camera means connected to the tube may be easily separated from the remainder of the apparatus so as to be easily cleanable and sterilizable.

With these objects in view, the apparatus according to the present invention mainly comprise a source of gas under pressure, an inflating tube insertable with one end thereof into the cavity to be inflated, tube means connecting the source of gas under pressure to the inflating tube, manually operable valve means connected to the tube means movable between a closed and open position for permitting in the open position flow of gas under pressure through the tube means and the inflating tube into the cavity to inflate the latter, sensing means cooperating with the tube means for sensing the gas pressure in the cavity transmitted to the tube means through the inflating tube, and automatic shut-off means connected to the sensing means for automatically shutting off further passage of gas under pressure into the cavity when the gas pressure in the latter has reached a predetermined value.

The automatic shut-off means preferably comprise a normally open solenoid valve and the sensing means comprise switch means for energizing the solenoid valve to move the latter to the closed position thereof when the pressure in the cavity sensed by the sensing means reaches the aforementioned predetermined value.

The source of gas under pressure preferably comprises a small gas tank which may contain air or CO₂ at a pressure considerably higher than suitable for feeding into the stomach and therefore the apparatus, according to the present invention, includes also an adjustable reducing valve between the tank and the automatic shut-off means for reducing the gas pressure passing from the tank to the inflating tube to a pressure suitable for inserting into the stomach, which should be inflated with the gas pressure of about 1 atmosphere over pressure. Preferably, the apparatus includes also pressure indicating gauges for indicating the pressure downstream of the reducing valve and for indicating also the pressure in the stomach during the inflation thereof.

Preferably, the gas tank, the reducing valve, the solenoid shut-off valve, the pressure sensing means and the aforementioned two gauges together with the tube means, for instance, rubber tube portions connecting the aforementioned elements to each other, are mounted in a carrying case for easy transportation and the two gauges are preferably mounted in one wall of the carrying case so that the scales thereof are visible from the outside of the latter. The end of the tube in the carrying case is connected preferably to a nipple projecting from a side wall thereof so that the inflating tube together with the manually operable valve and the means for actuating the camera and illuminating means at the end of the inflating tube may be connected to the nipple of the carrying case. This releasable connection of the aforementioned element to the nipple, permits to properly clean or sterilize the aforementioned elements before use.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic view of the apparatus according to the present invention and showing the end of the inflating tube and the camera and illuminating means connected thereto inserted into a stomach;

FIG. 2 is a schematic side view of the carrying case of the apparatus according to the present invention; and

FIG. 3 is a partially sectioned side view of the inflating tube, the camera and illuminating means connected to one end thereof, the camera actuating means and the manually operable valve which form with the actuating means one unit connected to the other end of the inflating tube.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing, and more specifically to FIG. 1 of the same, it will be seen that the apparatus according to the present invention for automatic inflation of cavities of the human body to a predetermined degree mainly comprises a source of gas under pressure, for instance a tank 1 containing gas, for instance air or preferably CO₂, under pressure of 30-50 atmospheres provided with the usual valve 1' at one end. The outlet end of the gas tank 1 is connected by a tube means 12, for instance a rubber tube, to the inlet end of an inflating tube 10, the outlet end of which is inserted into the cavity to be inflated, for instance the stomach of a patient. Since the pressure contained in the tank 1 is considerably higher than the pressure suitable for inflating of the stomach, a pressure-reducing or throttle valve 2 is provided downstream of the gas tank in the tube 12. This pressure-reducing valve, of known construction, is manually adjustable to obtain downstream of the valve 2 a pressure of, for instance, 1 atmosphere overpressure in the tube 12. A pressure gauge 3 communicating with the interior of the tube 12 is provided downstream of the valve 2 so that the reduced pressure obtainable by properly setting the valve 2 may be easily ascer-

tained. A manually operable valve 8, the construction of which will be described later on in detail, and which is easily movable between an open and a closed position, is provided immediately upstream of the inlet end of the inflating tube 10 so that by opening valve 8, gas at reduced pressure may pass through the tube 12 into the inflating tube 10 and through an outlet opening 10' into the stomach of the patient when the end of the inflating tube is inserted into the stomach.

To assure automatic inflation of the stomach to a predetermined degree, the present invention provides further pressure sensing means 5 in the tube means between the pressure gauge 3 and the manually operable valve 8 which senses the pressure in the tube means 12 which will substantially correspond to the gas pressure maintained in the inflated stomach. The pressure sensing means 5 is connected to a solenoid valve 4 provided in the tube 12 preferably between the pressure gauge 3 and the pressure sensing means 5 in such a manner to automatically interrupt further feeding of gas under pressure into the stomach when a pressure of predetermined degree is sensed by the pressure sensing means 5. Pressure sensing means suitable for the purposes described are known in the art, and for instance commercially produced by the Mercoird Corporation, Chicago, Illinois, and Mercoird pressure controls series D-200 have been found especially suitable for the present purpose. This pressure sensing means is extremely sensitive and can be manually adjusted so that the switch thereof may be actuated at a pressure of from one-eighth to 15 atmospheres. The switch 5' of the pressure sensing means 5 energizes, when closed, the solenoid coil 4' of solenoid valve 4 connected thereto to automatically close the valve when the pressure sensing means 5 senses the maximum pressure to which it is set. Various types of commercially produced solenoid valves may be used for the purposes described, and a solenoid valve produced by the Automatic Switch Company, Florham Park, New Jersey, has been found especially suitable for the purpose of the present invention. An additional pressure gauge 6 is preferably provided downstream of the pressure sensing means for indicating the pressure maintained in the interior of the stomach during inflation of the same. An additional manually operable valve 7 may also be provided in the tube means 12 between the pressure gauge 6 and the manually operable valve 8 for the purpose as will be described later on.

The gas tank 1, the reducing valve 2, the solenoid valve 4 and the pressure sensing means 5, connected thereto, as well as the pressure gauges 3 and 6, the manually operable valve 7, and the tube means 12 connecting the aforementioned elements, are preferably mounted in a carrying case 13, shown in FIG. 2, with the scales of the pressure gauges 3 and 6 mounted in a side wall of the carrying case so as to be readable from the outside thereof. The carrying case is of course openable and closable in the usual manner, and the gas tank 1 is mounted therein in any convenient way, well known in the art, to be easily exchangeable after exhaustion. The end of the tube means 12 distant from the gas tank 1 is preferably connected to a nipple 14 projecting beyond one end wall of the casing 13, whereas operating portions 2' and 7' for adjusting the reducing valve 2, respectively for opening and closing the manually operable valve 7, preferably project upwardly beyond the top wall of the casing to be operable from the outside thereof. The valve 7 is provided in the carrying case to stop any flow of gas to the nipple 14 when the latter is not connected to the remainder of the apparatus shown in FIG. 1, that is to the manually operable valve 8. The carrying case 13 is further provided with an electrical outlet 15, for instance on the same side wall as the nipple 14 is provided, for connecting the switch 5' of the pressure sensing means and the solenoid 4' of the solenoid valve 4 to a current supply.

FIG. 3 shows in further detail the inflating tube 10 and the various elements directly connected thereto which are in turn connected to the nipple 14 by for instance a rubber hose. The inflating tube 10 carries at the lower end thereof, which is to be inserted into the stomach of a patient, a special camera and

illuminating means 11, not forming part of the present invention of the type as for instance disclosed in the U.S. Pat. Nos. 1,828,141 or 2,349,932 to Back, whereas the upper end of the inflating tube 10 carries means 9 having an upwardly projecting operating button 22 connected to the camera and illuminating means 11 in the manner as described in the aforementioned patents to energize the illuminating means and to operate the shutter of the camera upon depression of the operating button against the pressure of a spring housed in the element 9. FIG. 3 shows also wires 23 extending from the element 9 which are connected in the tube 10 to the illuminating means cooperating with the camera and these wires are connectable at the outer ends in any convenient manner with a source of electrical energy. The manually operable valve 8 described above is connected to and forms one unit with the operating means 9 of the apparatus. As shown in FIG. 3, the valve 8 may comprise a substantially cylindrical housing 16, a plunger 18 axially movable in the housing against the pressure of a coil spring 17 mounted in the housing 16 beneath the plunger between a closed position as shown in FIG. 1 and an open downwardly depressed position in which the bore 19 in the plunger is axially aligned with the passage through the nipple 21 connectable to the nipple 14 on the carrying case by a tube so that whenever the plunger 18 is downwardly moved by the operating button 20 connected to the plunger 18, gas from the gas tank 1 may pass through the tube means 12, the nipples 14 and 21, into the interior of the housing of the operating means 9, and from there into the inflating tube 10 to pass from the lower end of the latter past the various joints of the camera means 11, or through a separate outlet opening 10' into the interior of the stomach when the lower end of the inflating tube is inserted into the latter.

The above-described apparatus will operate as follows:

The nipples 14 and 21 are connected by a rubber hose of suitable length to each other while the valves 7 and 8 are closed. The reducing valve 2 is then adjusted until the pressure gauge 3 indicates an appropriate reduced pressure downstream of the reducing valve. The pressure sensing means 5 are preferably permanently adjusted to close the solenoid valve 4 at a predetermined maximum pressure. The end of the inflating tube 10 carrying the camera and illuminating means 11 is then inserted into the stomach of the patient, after being properly cleaned and sterilized while the valve 7 and 8 remain closed. The valve 7 is then opened and subsequently thereto, the operating button 20 of the valve 8 is depressed so that gas from the tank 1 at the reduced pressure obtainable from the pressure-reducing valve 2 will flow through the inflating tube 10 into the stomach to inflate the latter. When the pressure of the gas thus fed into the stomach reaches the predetermined pressure, to which the pressure sensing means 5 has been set, the switch 5' of the pressure sensing means will close, energizing the solenoid 4' of the solenoid valve 4, to thereby close the normally open valve. This will stop further feeding of gas into the stomach, and the operator, after glancing on the scale of the pressure gauge 6, may now operate the operating button 22 for energizing the illuminating means and for operating the shutter of the camera 11 to thus take pictures of the interior of the inflated stomach. If the patient should belch before the operator depresses the button 22, the pressure sensing means 5 will instantaneously sense the thus reduced pressure in the stomach and momentarily re-open the solenoid valve 4 to re-establish the desired pressure in the stomach.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of apparatus for automatic inflation of cavities of the human body to a predetermined degree differing from the type described above.

While the invention has been illustrated and described as embodied in apparatus for automatic inflation of the stomach of a patient and for photographing the interior of the inflated stomach, it is not intended to be limited to the details shown, since various modifications and structural changes may be

made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of the invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims;

1. Apparatus for automatic inflation of cavities of a body, such as a stomach of a patient, to a predetermined degree, comprising, in combination, a source of gas under pressure; an inflating tube insertable with an open end thereof into the cavity; tube means connecting said source of gas under pressure to the other end of said inflating tube; manually operable valve means connected to said tube means movable between a closed and an open position for permitting in said open position flow of gas under pressure through said tube means, said inflating tube and said open end thereof into said cavity to inflate the latter; sensing means cooperating with said tube means for sensing the gas pressure in the cavity transmitted to said tube means through said inflating tube; and automatic shut-off means connected to said sensing means for automatically shutting off further passage of gas under pressure into said cavity when the gas pressure in the latter has reached a predetermined value, and for instantaneously restoring flow of gas into said cavity when the gas pressure in the latter after inflation of said cavity drops below said predetermined value.

2. An apparatus as defined in claim 1, wherein said automatic shut-off means comprises a normally open solenoid valve, and wherein said sensing means comprises switch means for energizing said solenoid valve to move the latter to the closed position thereof when the pressure in said cavity reaches a predetermined value.

3. An apparatus as defined in claim 1, and including a throttle valve in said tube means between said source of gas under pressure and said shut-off means for reducing the pressure of said source to a pressure suitable for inflating the cavity.

4. An apparatus as defined in claim 3, and including gauge

means communicating with said tube means downstream of said throttle valve for indicating said reduced pressure.

5. An apparatus as defined in claim 4, wherein said gauge means communicates with said tube means between said throttle valve and said shut-off means, and including additional gauge means communicating with said tube means between said pressure sensing means and said manually operable valve means for indicating the pressure in said cavity after said valve means has been opened.

6. An apparatus as defined in claim 1, and including photographic camera means at said one end of said inflating tube for photographing the interior of said cavity after the latter has been inflated, and actuating means at the other end of said inflating tube for actuating said camera means.

7. An apparatus as defined in claim 6, wherein said manually operable valve means and said actuating means at said other end of said inflating tube are connected to each other to form a unit.

8. An apparatus as defined in claim 5, wherein said source of gas under pressure is a tank containing a gas under pressure and including a carrying case housing said tank, said tube means, said throttle valve, said sensing means, said shut-off means and said gauge means connected thereto and cooperating therewith, said gauge means being mounted in one wall of said carrying case so as to be visible from the outside thereof, and said throttle valve having an operating portion projecting from the exterior of said carrying case.

9. An apparatus as defined in claim 8, and including a connecting nipple connected to the downstream end of said tube means and projecting through one wall of said carrying case to the exterior of the latter, and an additional manually operable valve connected to said tube means between said nipple and said additional gauge means and having an operating portion operable from the exterior of said carrying case.

10. An apparatus as defined in claim 9 and including photographic camera means at said one end of said inflating tube for photographing the interior of the cavity after the latter has been inflated, said camera means including actuating means at the other end of said inflating tube and forming with said first-mentioned manually operable valve means a unit releasably connectable to said nipple.

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