A system for the flushing of a body cavity (5) comprising a duct (3) connectable to a liquid source (2) with a pump (1) for the pumping of the liquid to a leading-in apparatus (4) for the liquid. Characteristic for the system is a pressure pick-up (19) arranged between the pump (1) and the said apparatus (4) which is adapted to control the pressure in the body cavity (5). The system in accordance with the invention is intended in particular to be used in conjunction with arthroscopy, the said leading-in apparatus for the liquid thus being constituted of an arthroscope with the help of which a knee-joint can be inspected and/or treated.
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TITLE
A SYSTEM FOR THE FLUSHING OF A BODY CAVITY

TECHNICAL FIELD

The present invention relates to a system for the flushing of a body cavity which is divided into a flexible tube set intended for single use, and a peristaltic pump with associated control system, intended for multiple use, the flexible tube set comprising a duct, connectable to a liquid source, with a pump segment for the pumping of the liquid to a leading-in apparatus for the liquid, and a draining duct connectable to the body cavity.

The system in accordance with the invention is intended preferably for the carrying out of arthroscopy, the said apparatus in this case, being constituted of an arthroscope. Such an apparatus is used, therefore, for inspection, flushing and possibly treatment of knee caps. However, the system in accordance with the invention can also be used for the flushing of other body cavities. For the sake of simplicity, though, it is described in the following in connection with its particular use in arthroscopy.

BACKGROUND ART

At present two systems for arthroscopy are on the market which supply the arthroscope with liquid during the actual examination. The one system comprises a bag suspended on a column approx. 1.5m above the patient. From the bag, a flexible tube then leads down to the arthroscope, and the inflow into the same is regulated with the help of a valve on the arthroscope itself. The liquid is drained from the knee with the help of a discharge cannula and a flexible tube. On this flexible tube, a clip is provided by means of which the flow can be opened and shut. The weakness of the system is that in case of the knee having expanded, the pressure from inside the knee will also act upon the flow, which means that the latter has to be adjusted all the time during treatment, according to the expansion of the knee.

In accordance with another system, liquid is supplied to the arthroscope instead with the help of an arthroscopy pump, the rate
of which can be controlled by means of a pedal. In this manner, the flow can be controlled without any need for using the hands, which are required partly to manoeuvre the arthroscope, partly to control the other operational instruments which are introduced into the knee cap.

A further advantage of using a pump, is that the pump can overcome the internal pressure which is present in the knee. Consequently, it is possible to keep the flow through the knee relatively constant. The flow made use of here ranges from drop rhythm up to 300-400 ml per min. If, for example, an electric "shaver" is used for taking out material, flows right up to 700 ml/min may be required. Owing to the height of the ceiling in normal operating theatres, such flows can be obtained only with the help of pumps, and not with the help of the system described first, which normally gives only a pressure of approx. 150 cm water gauge.

If a pump is used as a driving source, appreciably higher pressures can be obtained. However there is a risk involved here that the physician, through maladjustment of the pump or careless handling of the same, may burst the capsule of the knee-joint. As a result of this, certain physicians, who previously never had to do with arthroscopy, feel apprehensive at the prospect of using the system. It also means that in countries such as e.g. the U.S.A., where the physician very easily can be sued for wrong treatment, it would be desirable to provide further protection on the equipment so as to make it possible, for example, to monitor the maximum pressure which the pump can attain.

DISCLOSURE OF INVENTION

To prevent the abovementioned risks, a system of the aforesaid type has been developed in accordance with the invention, which is characterized by a pressure gauge connectable to the duct between the pump and the body cavity, which is adapted to control a draining valve provided in the draining duct for the control of the pressure in the body cavity.
The said pressure gauge can be adapted so as to open the valve in the draining duct when a certain, preferably adjustable, pressure is attained in the body cavity. Should the pressure in the body cavity increase further, in spite of the opening of the valve, the pressure gauge may be adapted further to stop the rise in pressure by means of adjusting the pump or wholly stopping the pump when a certain, preferably adjustable, maximum pressure is attained in the body cavity. It is possible thus to counteract undesirable pressure increases and, moreover, to prevent completely that a certain maximum value is exceeded.

Means for the joint control of the said two adjustable pressures are suitably arranged so that the valve in the draining duct always opens when the pressure in the body cavity attains a certain fraction of the said maximum pressure.

To give the physician even greater freedom of action, the valve in the draining duct may also be controllable by hand.

The system in accordance with the invention is divided appropriately into a flexible tube set intended for single use, comprising a pump segment and a peristaltic pump, e.g. a normal hose pump, with associated control system, intended for multiple use. The flexible tube set may be provided with a branch duct following the pump segment, this branch duct being capable of being connected to the pressure pick-up via a liquid-tight but gas-permeable filter. In this manner, the pressure pick-up intended for multiple use is not contaminated. Alternatively, a wholly impermeable and elastic filter may be used for the same purpose.

The said branch duct, furthermore, may comprise a vent valve, which preferably is constituted of a self-closing membrane which can be penetrated by a cannula. In this way, the system can be vented in a simple manner by a conventional injection syringe. Alternatively, a liquid-tight but gas-permeable membrane can be used for this purpose through which the system is continuously vented.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention will be described further with reference to the enclosed drawings, which, by way of an
example, show a preferred embodiment of the system in accordance with the invention.

Fig. 1 shows schematically a relatively complete system according to the invention in its practical embodiment.

Fig. 2 and 3 show in the form of diagrams how the flow and the pressure respectively can be altered in conjunction with a treatment using the system in accordance with the invention.

BEST MODE OF CARRYING OUT THE INVENTION

In fig. 1 a system intended for arthroscopy is shown as an example of the system in accordance with the invention. This system comprises a pump 1 for the pumping of liquid from a liquid source 2 via a duct 3 to a leading-in apparatus 4 for the liquid, which in the example consists of an arthroscope for the pumping of the liquid into a knee joint 5. The liquid source 2 is constituted in the example shown of a bag suspended on two hooks 6 in a stand 7. The connection between the duct 3 and the bag 2 is designated 8. In the simplest case, this connection may consist of a simple cannula inserted into the bag. The duct 3 consists of two parts and a pump segment 9 arranged in between which may consist, for example, of silicone rubber, whilst the duct itself consists of a somewhat more rigid material, e.g. PVC. With the help of a clamping device 10 the pump segment 9 is stretched over three of four rolls 11 on a pump rotor 12. By a modification of the clamping device the capacity of the pump can be altered. This can be done with the help of a pedal 13 which is connected to the driving motor of the pump via an electric cable 14.

The system shown further comprises a draining duct 15, connectable to the knee, with a valve 16. The connection is made with the help of the cannula 17 shown schematically.

The duct 3 comprises, moreover, a branch duct 18, which is connected to the main duct with the help of a T-piece 18a at a point following the pump segment 9. This branch duct 18 is connectable to a pressure pick-up 19 via a liquid-tight but gas-permeable filter 20. The branch duct further comprises a vent valve 21 which, in the example shown, includes a self-closing membrane
which is penetrable by a cannula 22. The pressure pick-up 19 which, in fig. 1 is indicated only by its outer connecting part, is adapted so that, via a cable 24, it controls the valve 16, and hence the pressure in the knee 5. This is done appropriately in that the valve 16 is opened when a certain pressure is attained in the knee 5. A further safety is obtained if the pressure pick-up, moreover, is adapted so as to stop further rise in pressure by adjusting or wholly stopping the pump when a certain maximum pressure in the knee is attained. Such a situation can arise, for example, if the draining duct for some reason, becomes stopped up.

In fig. 2 is shown by way of example how the flow Q can be varied in conjunction with the use of the system in accordance with the invention for arthroscopy. At A a normal flow is initiated which at a time B is increased, for example, for the flushing away of blood for the improvement of visibility. This is done appropriately manually by the physician. At point C, the flow returns to normal, to be increased again at D, for example, for the flushing away of material after an operation. Should a stopping up occur in this connection in the draining duct 15 at E the flow continues wholly or partly unchanged up to a point F. If the stopping up is total, the pump stops altogether, so that the flow drops according to the dotted line. At a partial stoppage, the control is changed over instead from a control of constant flow to a control of constant pressure, the flow possibly diminishing in accordance with the fully drawn line. The broken line indicates what would happen instead in a system without protective devices in accordance with the present invention. Here the flow would continue unchanged up to the point G, where at best it would be changed over manually by the physician. If this fails to be done, the flow would continue unchanged until a bursting of the capsule of the knee-joint takes place.

In fig. 3 is shown a pressure diagram corresponding to the flow diagram described above. Thus at A a normal flow is initiated the closed valve 16 closed. The pressure P then gently increases up to point B when the flow is increased, for example, for the flushing away of blood or the like. The increased flow
brings about a rapid rise in pressure up to point C where the flow returns to normal. The pressure then rises slowly up to point C’ where the physician opens valve 16 by hand. At C” the valve is closed again, whereupon the pressure commences again to increase. This pressure increase is intensified at point D and reaches, at point D’, a level P’, where valve 16 is opened automatically. The pressure then can be maintained substantially constant, or it increases slowly up to point E where the draining duct is wholly or partially stopped up. This brings about a more rapid rise in pressure up to a level P max at point F, where the pump is changed over from control of constant flow to control of constant pressure. Hence, this pressure level is not exceeded. By contrast, the broken line indicates what might happen in a system without protective arrangements in accordance with the present invention. The pressure would then rise until either the pump is shut off, or switched over by hand or until the capsule of the knee joint has burst.

Naturally the invention is not limited solely to the particulars described above, but can be varied within the scope of the following claims. For example, pumps other than that shown may also be used.
CLAIMS

1. A system for the flushing of a body cavity (5) which is divided into a flexible tube set (3, 9, 15, 18) intended for single use and a peristaltic pump (1) with associated control system intended for multiple use, the flexible tube set comprising a duct (3) connectable to a liquid source (2) with a pump segment (9) for the pumping of the liquid to a leading in apparatus (4) for the liquid and a draining duct (15) connectable to the body cavity (5), characterized by a pressure gauge (19) connectable to the duct (3) between the pump (1) and the body cavity (5), which is adapted to control a draining valve (16) provided in the draining duct (15) for the control of the pressure in the body cavity (5).

2. A system in accordance with claim 1, characterized in that the said flexible tube set is provided with a branch duct (18) following the pump segment (9), this branch duct being connectable to the pressure pick-up (19) via a liquid-tight but gas-permeable filter (20) or an elastic, tight membrane.

3. A system in accordance with claim 2, characterized in that the said branch duct (18) comprises further a vent valve (21), which preferably comprises a self-closing membrane (23) which can be penetrated by a cannula (22).

4. A system in accordance with anyone of claims 1-3, characterized in that the pressure pick-up (19) is adapted to open the valve (16) in the draining duct (15) when a certain, preferably adjustable pressure in the body cavity (5) is attained.

5. A system in accordance with anyone of claims 1-4, characterized in that the pressure pick-up (19) is adapted to stop further rise in pressure through adjustment of the pump (1) or complete stopping of the pump when a certain, preferably adjustable maximum pressure in the body cavity (5) is attained.

6. A system in accordance with anyone of claims 1-3, characterized in that the valve (16) in the draining duct (15) is also controllable manually.

7. A system in accordance with claim 4 and 5, characterized by means for the joint control of the said two adjustable
pressures, so that the valve (16) in the draining duct (15) always opens when the pressure in the body cavity (5) attains a certain fracture of the said maximum pressure.
INTERNATIONAL SEARCH REPORT

International Application No. PCT/SE84/00258

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 3

According to International Patent Classification (IPC) or to both National Classification and IPC

A 61 M 1/00

II. FIELDS SEARCHED

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Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 5

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

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* Special categories of cited documents: 15

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search 1 1985-02-12

Date of Mailing of this International Search Report 1 1985-02-14

International Searching Authority 1 Swedish Patent Office

Signature of Authorized Officer 29

L.E.