

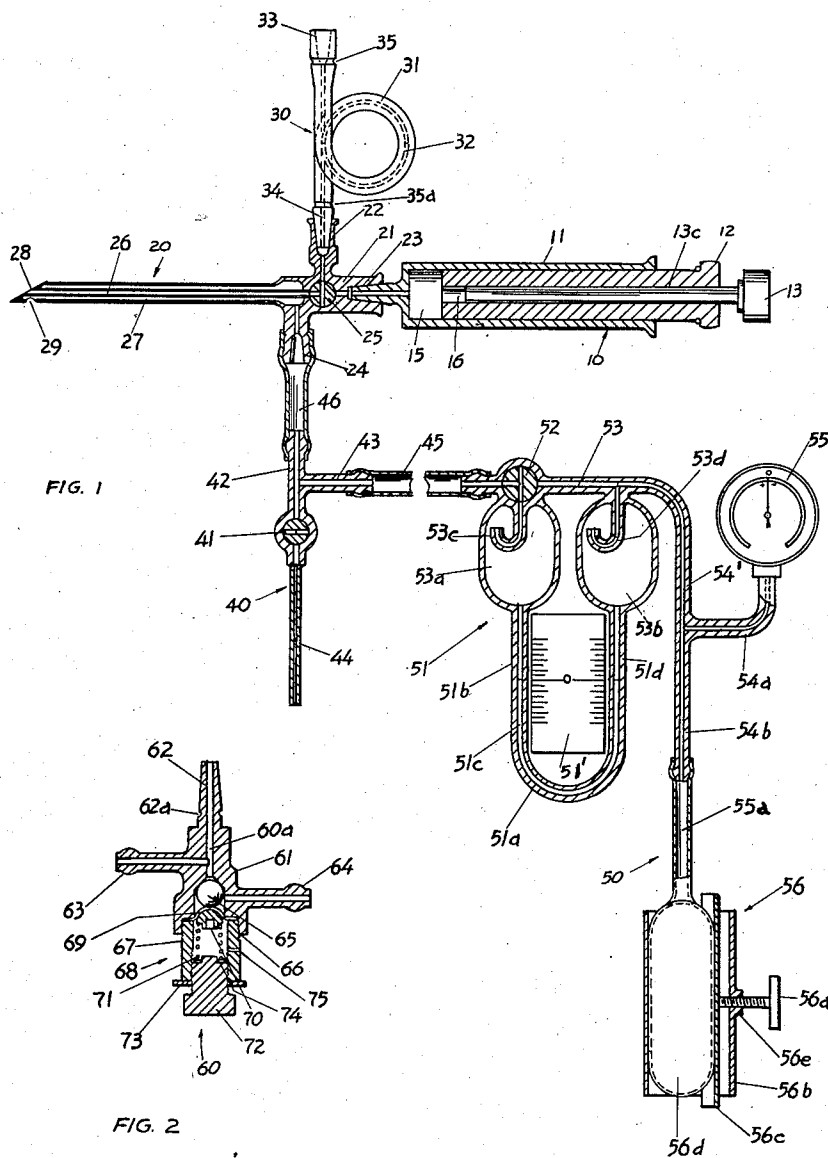
July 21, 1953

QUANG HSI HU
MEDICAL APPARATUS

2,646,042

Filed May 18, 1951

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

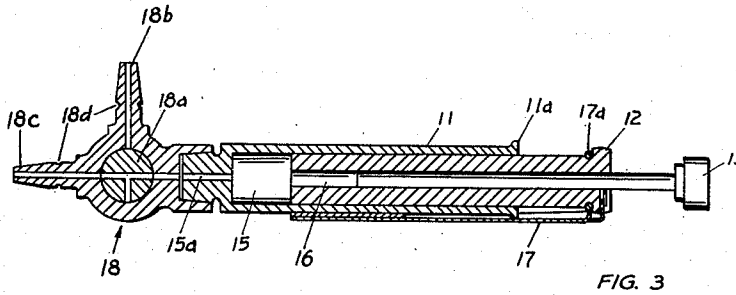


FIG. 3

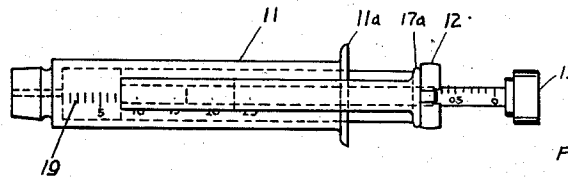


FIG. 4

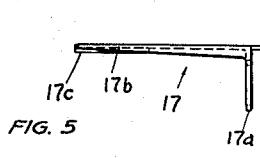


FIG. 5

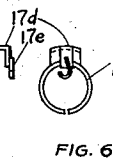


FIG. 6

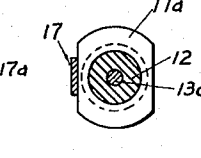


FIG. 7

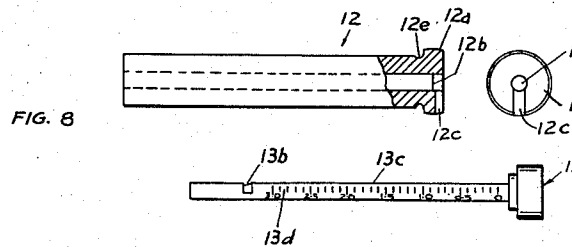


FIG. 8

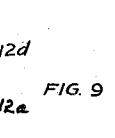


FIG. 9

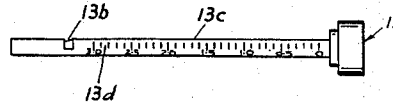


FIG. 10

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MEDICAL APPARATUS

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Application May 18, 1951, Serial No. 227,053

10 Claims. (Cl. 128—214)

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This invention relates to medical apparatus and more particularly to a medical device for simultaneously injecting and extracting body fluids under constant pressure indicating and control conditions.

In the medical art, various types of syringes and medical apparatus are used for extracting fluids from and injecting others into the body. These types of apparatus usually contain a syringe with a multiple-way valve and a hypodermic needle so that by operating the valve once the needle has been inserted into any part of the body, the fluid is withdrawn by means of one of the syringes from the body. After this operation has been completed fluids of any suitable kind or air, depending upon the kind of operation being performed by the physician, is forced into the body through said syringe needle. It is apparent that this process is tedious with such type of apparatus particularly since provision is made in such type of apparatus for a simultaneous extraction of fluid from the body and injection of necessary fluid or air into the body with constant pressure control of the body cavities. Nor is there any control of the fluid pressure in the body. Furthermore, it is oftentimes exceedingly difficult even to the skilled surgeon and physician to make such injections and body fluid extractions. It fact there are known to be instances where the insertion of a syringe needle into some part of the body without knowing how to control the pressure of such fluids in the body or counter-balance the body fluid pressure has caused considerable and needless pain and suffering to the patient. The pressure drop caused by the removal of such fluids without providing any hydrostatic pressure control and compensation may cause a state of severe shock.

With the above disadvantages in view, it is a primary object of my invention to provide an easily operable medical device which permits simultaneous extraction of fluid of one kind from the body and simultaneously injecting a fluid of another kind or air into the body, while at the same time controlling the pressure of the fluids being extracted from the body and/or being injected into the body.

The hydrostatic pressure within the body cavity will be controlled by suitably maintaining the outflowing of the body fluid and the injecting speed of another kind of fluid or air into the body.

A new pressure indicating device according to my invention, makes this operation to be controlled much easier and safer.

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Another object of my invention is to provide a device used for measuring the pressure within the body cavity without losing any of the fluid.

In accordance with my invention, the pressure condition will remain constant in the body. The usual method of measuring the pressure of the body cavity, for example the intrathecal pressure, is performed by using a hypodermic needle connected with a pressure gauge or a U-tube filled with fluids. As a result of pressure differences between the body cavity and the atmosphere, the body fluid will be flowing out into the hypodermic needle and compressing the air within the pressure gauge or the fluids in the U-tube or the air will be sucked into the body. In other words, the condition within the body cavity has been already affected by such a procedure. It might be the cause of dangerous complications such as hemorrhage or shock. Death may occur suddenly as in the case of intracranial tumors.

To offset this danger, it is another object of my invention to provide a device with a needle, a syringe, an equalizing indicator, pressure compensator and manometer or pressure gauge, by means of which the body fluid will be prevented from flowing out of the body cavity except as desired and any changes of pressure within the body cavity will be noticed promptly.

The usual types of manometer to measure the pressure within the body cavities are pressure gauges of spring type or U-tubes filled with water or mercury. With the exception of the U-tube filled with water, the others cannot give the fractional readings, but the water U-tube is about one meter long and therefore very inconvenient to use, for example, in clinics or doctors' offices. The device made according to my invention does not have such disadvantages.

The attached syringe made according to my invention, is designed for injecting relatively large quantities of fluid or air continuously without detaching the syringe from the inserted hypodermic needle or manipulating a three-way valve. Furthermore, the syringe in my invention is used for effecting a slow injection of fluids, for example, strophanthin or calcium salt solution and for injecting a fluid of high viscosity and with a fine calibered hypodermic needle easier, and for diluting a solution in a large ratio within the syringe containing the fluid to be injected for making the mass treatment convenient or for saving time and work with accurate dosages.

A flow indicator according to my invention, will help the physician quickly to locate the place where he desires to puncture the body. The loop

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of the capillary tube in my invention permits the flow indicator to be attached in any position without the indicating fluid escaping from the device.

Another object of my invention also is to provide a flow regulator to control the outflow of the body fluid and which can be replaced by the designed pressure regulating valve or attachment.

Other objects, advantages and features of my invention will become apparent from the hereinafter described invention taken in connection with the accompanying drawings, in which:

Fig. 1 is a general view of a preferred embodiment of my invention;

Fig. 2 is a sectional view of a pressure regulating valve also forming part of my invention;

Fig. 3 is a longitudinal sectional view of a syringe forming part of the embodiment;

Fig. 4 is a front view of the syringe shown in Fig. 3; and

Figs. 5 through 10, inclusive, are detail views of parts of the syringe shown in Figs. 3 and 4.

Referring now to the drawings in which like reference numerals refer to like parts throughout, it will be noted that according to my invention, I provide a syringe 10, a dual channel needle 20, a flow indicator 30, a flow regulator 40, a calibrated pressure indicating equalizer device 51, a compensating device 56, and a pressure regulating valve or attachment 60.

The syringe 10, as shown in Fig. 1, is provided with a cylinder 11 which can be provided with a single nozzle opening as shown in Fig. 1 or with a combination of a three-way valve 18a with two outlets 18b and 18c with grooves 18d for rubber tubing connection, as shown in Fig. 3. There is provided in said syringe 11, a longitudinally movable interplunger 12, a flat indicating holder 17 and plunger 13. The cylinder 11 and the interplunger 12 are preferably made of transparent material. Also, said cylinder is graduated, as shown. The plunger 13 may be made of metal or transparent material. Said cylinder 11 and plunger 13 have graduations 19 and 13d, respectively, as shown in Fig. 4. The unit of the graduations on the plunger 13 is only a fraction of that on cylinder 11. Said cylinder 11, furthermore, is provided with a head or collar 11a. On one of the flat surfaces, the indicating holder plate 17b can be allowed to slide only in the direction of the cylinder axis. One end of said indicating holder plate 17b is mounted with ring 17a. This ring 17a is fixed in the groove 12e on the interplunger 12.

Stop 17e, is hook shaped, is made of metal wire and is connected through an L-shaped rod 17d with the indicating holder plate 17b. The stop 17e and the joined part of the L-shaped rod 17d are fixed in the groove 12c on the flange 12a of the interplunger 12 and its loop projects into the bore 12d. Plunger 13 is allowed to slide below the stop 17e, until the latter falls into the groove 13b on the plunger 13, as shown in Fig. 10. By rotating the plunger 13 around its axis it can be pulled out of the interplunger 12 so that the stop 17e can be pushed out of the groove 13b on the plunger 13. The groove 13b is so formed that it allows plunger 13 to be pushed in the direction for injecting but not for withdrawing.

It will be noted that said stop 17e may be separated and fixed in groove 12c. It also may be disconnected from L-shaped rod 17d to permit

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rotation of interplunger 12. Interplunger 12 is a thick walled cylinder whose outside and inside walls are fitted closely to the cylinder 11 and the plunger 13, respectively. It will also be noted that the interplunger 12 is allowed to slide between the cylinder 11 and the plunger 13 and is provided with a flange 12a and an annular groove 12e in which the ring 17a of the indicating holder 17 is fixed and groove 12c in which the stop 17e is fixed. On the inside wall of the flange 12a there is a marking 12b, as shown in Fig. 8. This marking indicates the amount of fluid or air that has been withdrawn when read against the scale 13d of the plunger 13. The surface of the flange 12a is convex and operates as a magnifying glass so that the scale 13d may be easily read.

For withdrawal of fluid or air, interplunger 12 will be pulled back and the plunger 13 will also be automatically pulled back. The free end of the indicating holder plate 17b has the same length as the interplunger 12 and is rubber lined on its under surface 17c, as shown in Fig. 5. The amount of the fluid withdrawn will be indicated on the scale 19 on the cylinder 11. The fluid within the space 15 as shown in Fig. 3 will be injected to a definite extent by pushing the plunger 13 which would push the interplunger 12 automatically in the same direction if the plunger were continually pushed. If a fractional amount of fluid is to be injected into the body then the interplunger 12 will be pushed forward and the plunger 13 will be pushed back, the fluid filling the space 16 according to hydraulic principle until the required amount is obtained. Indicating holder plate 17b will be pushed down against the outside wall of the cylinder 11 and held by the finger of the physician so that the interplunger 12 is fixed and not allowed to be pushed back when the plunger 13 is being pushed forward. The fluid in the space 16, as shown in Figs. 1 and 3, will be pushed into the space 15. From said space 15 the fluid exercises hydraulic pressure upon the interplunger 12 and against the opening 15a, Fig. 3, to the attached hypodermic needle. As a result of the interplunger 12 being fixed by the indicating holder plate 17b against the cylinder 11 by the finger, the fluid will be forced into the hypodermic needle only. The procedure can be repeated continuously for mass treatment.

After the solution has been drawn into the syringe by pulling the interplunger 12 back to let the syringe become filled with the required amount of the fluid in the space 15, the interplunger 12 then is pushed and the spacer 16 will be automatically filled with the solution. Interplunger 12 will be fixed by pushing the indicating holder plate 17b against cylinder 11. The fluid in the space 16 will be forced into the space 15 by pushing the plunger 13 against the syringe opening 15a, as shown in Fig. 3. The fluid in space 15 will be forced into the hypodermic needle 20 through the opening 15a. This operation is continued until the whole amount of the fluid in the syringe has been used up. This procedure is especially convenient when injecting fluids of high viscosity or when a fine calibrated needle has to be used. If the syringe is used for diluting, then the interplunger 12 will be fixed in the usual way, as above described. The fluid to be diluted will be withdrawn by pulling the plunger 13 back to the required amount indicated on the scale 13d. The diluting fluid, water or saline solution, for example, will be withdrawn by pulling back the

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interplunger 12 to the required amount indicated in the scale 19. Stop 17e on the indicating holder 17 will prevent the plunger 13 from sliding out of the interplunger 12. In the syringe 11, as shown in Figs. 3 and 4, it will be noted that holder 17 may be readily separated or fixed in groove 12c. Also, such holder 17 may be disconnected from rod 17d to permit selective rotation of interplunger 12.

The dual channel needle 20 is already fully described in my copending application Serial Number 71,600, filed January 19, 1949, which has now matured into U. S. Patent No. 2,564,977, issued August 21, 1951. As described in said application, the needle provides a body member 21 with two inlets 22 and 23 and an outlet 24, and a three-way valve 25 which can be rotated into any desired position according to the kind of operation to be used by the physician or technician. Said needle is also provided with two channels 26 and 27, respectively, and with an opening 28 for channel 26 and a side opening 29 for channel 27, as shown in Fig. 1. It will allow simultaneous extraction of the body fluid and injecting fluid of other kind or air into the body.

Inlet 22 in said body member 21 is connected with a flow indicator 30 which is of circular or spiral construction. Outlet 24 is connected with a rubber tubing 46 or directly to a flow regulator 40 or a pressure regulating valve 60, as shown in Figs. 1 and 2. Flow indicator 30 is a circular or spiral shaped capillary tubing. Its upper end 33 is flared to allow attaching thereto the tapered opening of a hypodermic syringe, not shown. The other end 34 is tapered to allow its attachment to body member 21, as shown in Fig. 1. Both ends 33 and 34 provide grooves 35 and 35a respectively, for rubber tubing connection. Within the loop 31 there is an indicating fluid 32 of any suitable type. Said flow indicator 30 is made of transparent material. As a result of its spiral shape indicator 30 can be put into any position without the indicating fluid 32 escaping from the flow indicator 30.

As soon as the opening 28 of the needle 20 reaches the desired portion of the body cavity being punctured, the fluid will flow into the channel 26 and the air will be pushed from the channel 26 into the flow indicator whereupon the indicating fluid in the indicator 20 starts to move. The physician will know that the opening 28 is at the right place and need not push the needle any deeper into the body. Then the valve 25 is adjusted so that the channel 28 is closed to the flow indicator 30 and open to the attached syringe 10.

Flow regulator 40, as shown, is provided with a T-shaped tubing 42, a stop cock 41 and a capillary tubing 44. Stop cock 41 may be closed to the capillary tubing 44 if desired. The outlet 24 of needle 20 connects the end of T-shaped tubing 42 of the flow regulator 40 through a rubber tubing 46 while the other end of tubing 42 connects with the calibrated pressure indicating device 51 via rubber tubing 45.

Pressure regulating valve 60, as shown in Fig. 2, is provided with a tapered stem 62 having a groove 62a for rubber tubing connection. Stem 62 is adapted to fit into any of said inlets. Said pressure regulating valve or attachment 60, furthermore, is provided with a central channel or conduit 60a and side entering channels or conduits 63 and 64, respectively. Conduit 63 is adapted to accommodate a manometer or pressure indicating device 50 while conduit 64 can be connected in any suitable manner with a syringe

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or suction device. It will be noted that the valve 60 may be used in lieu of flow regulator 40.

Said conduit 60a is enlarged at the end opposed to the stem 62 to accommodate a regulating ball member 65. Said enlarged portion of the conduit 60a has a threaded portion 66 for accommodating the externally threaded bonnet 67 of the manually operable check ball valve unit 68. Said valve unit consists of a flexible diaphragm 69, against which is a holding member 70, a spring member 71, a screw member 72, a nut washer member 73 and a washer member 74. The movement of diaphragm 69 against ball member 65 is controlled and therefore the desired pressure to be maintained in conduit 60a and passage way 27 as well as in the human body around the side opening 29 of the needle 20 inserted in the body can be controlled by adjusting the screw member 72. The purpose of this unit is to control the pressure under which fluids may be added to the body or removed from the body. Said unit 60 is further provided with an air escape opening 75.

Pressure indicating device 50 is provided with a pressure equalizing indicator 51, a three-way valve 52, a bypass 53, an extending arm 54, a manometer or pressure gauge 55 and a pressure compensator 56. The pressure equalizing indicator 51 is provided with U-tube 51b with an indicating fluid 51c and an indicating scale 51'. At the ends of its two arms there are provided two bulbs 53a and 53b within which there are two hook tubes 53c and 53d. The hook tube 53c is in connection with the outlet 43 and the bypass 53 through three-way valve 52. It will be noted that the valve 52 can be rotated in any desired position depending on the operation of the indicator 51. The hook tube 53d is connected with the bypass 53, the manometer or pressure gauge 55 and the pressure compensator 56 through the tubing 54', 54a, 54b and rubber tubing 55a. Said valve 52 may be set on tube 53 intermediate the hook tubes 53c and 53d.

The pressure compensator 56 is provided with a rubber bulb member 56d, a horseshoe shaped supporting plate member 56b with a tap hole 56e, adjusting screw member 56a and adjusting plate 56c. The rubber bulb member 56d will be compressed or decompressed by the action of the adjusting screw member 56a against the adjusting plate member 56c as shown in Fig. 1. The valve member 52 will be placed in the position as shown in Fig. 1, so that as the channel 27 of the needle 20 is in communication with the equalizing indicator 51, and the stop cock member 41 of the flow regulator 40 is closed to its capillary part 44 at the same time. The pressure at the opening 29 of the needle 20 will be transmitted to the pressure equalizing indicator 51 and the indicating fluid 51c will be pushed in the arm 51b of the U-tube 51a downward and in the arm 51d upward. The difference between the arms 51d and 51b will be cancelled by compressing the rubber bulb member 56d of the pressure compensator 56. The body fluid in the channel 27 of the needle 20 will be pushed back and prevented from further flowing into the channel 27 by the compensating pressure in the pressure indicating device 50. Thus there will be no body fluid lost by this kind of pressure measuring device and the true value of pressure can be obtained thereby. The condition in the body remains unchanged. This is very important for measuring the intrathecal pressure with suspect of an intracranial tumor. By opening the stop cock member 41 of the flow regulator 40 to the atmosphere the pressure in the pressure

indicating device 50 and at the opening 29 of the needle 20 will drop as a result of any body fluid flowing out. The pressure within the body will be reduced in the same ratio. The indicating fluid 51c will be pushed downward into the arm 51d and upward in the arm 51b by the compressed air in the manometer or pressure gauge 55 and its connecting tubings.

The difference in pressure, as shown by the fluid between the arms 51b and 51d will be cancelled by injecting fluid or air through the syringe 10, channel 26, opening 28 of the needle 20 into the body after the three-way valve member 25 has been adjusted so that the passage from the syringe 10 to the opening 28 is open while it is closed to the flow indicator 30. The body cavity pressure will be kept constant by maintaining the injection speed or rate and the outflow of the body fluid and will be controlled by the pressure equalizing indicator 51. The fractional reading of pressure will be made on the indicating scale 51'. It will be noted that the bulbs 53a and 53b and the hook tubes 53c and 53d will prevent the indicating fluid 51c from escaping from the equalizing indicator 51 at the moment when the pressure changes suddenly in case of the needle being detached from the body. The pressure equalizing indicator can be put out of operation by adjusting the three-way valve 52 so that the channel 27 of the needle 20 communicates directly with the manometer or pressure gauge 55 and the pressure compensator 56 through the bypass 53.

It will be noted from the foregoing description of my invention, that it can be used for puncturing various parts of the body such as the cerebrospinal canal, the thorax cavity, joints, sinuses, abscesses, arteries, veins and the eyeballs. Also the attached pressure indicating device can be modified for measuring the blood pressure and the oscillation of the arterial pressure which will be indicated by the pressure equalizing indicator. The flow indicator can be used for puncture of any body cavities, abscesses and vessels as a great aid for the physician to localize his desired puncture places and the patient will thereby suffer less. Particularly by my invention I can use it in combination with the said syringe 10 with a three-way valve as shown in Fig. 3 for intravenous injection of solutions of high viscosity and a fine calibered hypodermic needle.

While a preferred embodiment of my invention has been described in connection with the accompanying drawing, it is to be understood that various changes or modifications as to the form, arrangement of parts, and use of materials may be made without departing from the spirit and scope of the invention as claimed herein.

I claim:

1. Medical apparatus for injecting into and withdrawing fluids from the body, comprising a body member having a three-way passage and a needle with a multiple channel in communication with said passage, operable means for selectively passing fluid through the passage, selectively rotatable plug means for directing the flow of fluids through the body member, and syringe means attachable to the body member having an interplunger and a measuring plunger movable in the interplunger to regulate the flow of fluid through the body member into one of the channels of the needle, said needle having a channel with an external side opening disposed short of the puncturing end thereof and being concentric with respect to the axis of the needle.

2. Medical apparatus, for injecting into or extracting controlled quantities of fluids from the

body under regulable controlled hydrostatic pressure conditions, comprising a multiple channel needle, a three-way plug in connection with said needle, and a syringe in connection with said plug having an interplunger and a plunger longitudinally movable and concentric with said syringe, for injecting controlled quantities of fluid into the body.

3. Medical apparatus for injecting into or extracting fluids from the body under regulable controlled hydrostatic pressure conditions, comprising a multi-channeled needle, a body member in connection with said needle, a syringe in connection with said member having a plunger and an inner longitudinally movable concentric measurement adjusting member, fluid control regulating means in connection with the body member, to permit the flow of a fluid therethrough into one of the channels of the needle, as fluid is withdrawn from the body through the other channel and directed through the body member by said means in the body member.

4. Medical apparatus for injecting into or extracting fluids from the body under regulable controlled hydrostatic pressure conditions comprising a multichanneled needle, a three-way body member in connection with said needle, a syringe in connection with said member having a plunger and an inner longitudinally movable concentric measurement adjusting member in said plunger to inject minute quantities of fluid into the body, regulable drainage means in connection with said needle to permit the flow therethrough of fluids being removed by the needle and syringe from the body, and equalizing measuring means in communication with the drainage device for determining and equalizing the pressure between the body fluid being withdrawn from the body and the fluid being injected therinto by the syringe.

5. Medical apparatus for injecting into or extracting fluids from the body under regulable controlled hydrostatic pressure conditions comprising a dual channelled needle, a three-way plug in connection with said needle for selectively directing the flow of fluids through the plug, a syringe in connection with said plug having an interplunger and an inner longitudinally movable concentric measurement adjusting member, a fluid passage regulator in connection with the delivery passage directly communicating with the channel of the needle, and adjustable compensating means in connection with the regulator to compensate for any difference in pressure shown by said equalizing means.

6. Medical fluid injecting and extracting apparatus comprising a two-way needle, a body member, a three-way plug in the member in connection with said needle, a syringe connected with said plug having a plunger and an interplunger, said plunger and interplunger being relatively movable with respect to each other and with said syringe, said needle having a pair of independent channels one of which is in communication with the multiple-way plug and the other is in direct communication with the control means, said last named channel being closed at the puncturing end of the needle but opened to the side thereof.

7. Medical fluid injecting and extracting apparatus under controlled hydrostatic pressure conditions, comprising a multiple channelled needle, a body member, a three-way plug in the member in connection with said needle, a syringe connected with said plug having a plunger and a graduated interplunger, said plunger and inter-

plunger being relatively removable with respect to each other and with said syringe, a spiral pressure flow indicator in connection with said plug, regulable fluid drainage means in connection with said needle, a pressure equalizer in connection with said drainage means for indicating and equalizing the pressure between the body fluid and the fluid being forced into the body by said syringe, and compensatory pressure regulable means in connection with said equalizer adapted to compensate for the differences in pressure arising from the extraction of fluid from the body and the injection of fluid into the body, said equalizer device having two-way means for bypassing the pressure exerted therein from the drainage means to the compensating device.

8. Medical fluid injecting and extracting apparatus comprising a needle, a body member, a three-way plug in the member in connection with said needle, a syringe connected to said plug having a plunger and an interplunger, said plunger and interplunger being relatively movable with respect to each other and with said syringe, stop means for said plunger and interplunger, and means attachable to the body member to regulate the flow of fluid through the body member into one of the channels of the needle, said needle having a channel with an external side opening disposed short of the puncturing end thereof and being concentric with respect to the axis of the needle.

9. Medical apparatus according to claim 2, in which the plunger is calibrated, has a cross sectional groove adjacent the end insertible into the

syringe, the interplunger has an annular groove at one end, a longitudinally extending recess at said end and an index marking adjacent said end, a holder having an annular member surrounding the interplunger at one end, and a longitudinally extending angularly bent member slidable along the periphery of the syringe, an L-shaped hooked member connected at one end to the interplunger and having its other end fixed to the longitudinally extending angularly bent member, adapted to be fixed in the recess of said plunger.

10. Medical apparatus according to claim 2, in which the interplunger is provided with a holder having an annular member surrounding the interplunger at one end, and a longitudinally extending angularly bent member slidable along the periphery of the syringe, an L-shaped hooked member slidably connected at one end to the interplunger and having its other end fixed to the longitudinally extending angularly bent member, adapted to be fixed in the recess of said plunger.

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