[54] MEANS FOR AND METHOD OF TRANSFERING BLOOD FROM A PATIENT TO MULTIPLE TEST TUBES WITHIN A VACUUM

[72] Inventors: Raymond S. Michel; Fred W. Podhora, both of Portland, Oreg.


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Primary Examiner—Dalton L. Truluck
Attorney—James D. Givman

[57] ABSTRACT

Apparatus for drawing and controlling blood flow from a single venipuncture through a flexible catheter into a sealed vacuumized container and simultaneous delivery to a number of test tubes within the container. The catheter is in open communication at one of its ends with a hypodermic needle and at its opposite end through a first flow control valve with the interior of the test tube container by means of a cap which directs blood flow equally and simultaneously to the test tubes within the container.

5 Claims, 7 Drawing Figures
MEANS FOR AND METHOD OF TRANSFERING BLOOD FROM A PATIENT TO MULTIPLE TEST TUBES WITHIN A VACUUM

This invention relates to improvements in instrumentilities of the character above described for use by the medical profession in drawing multiple blood samples simultaneously from a patient by a single venipuncture for examining, testing and other analogous purposes.

There exists a constant recurring clinical need for a simple, safe, economic and positive means which may be used with requisite finesse and dexterity while drawing multiple blood samples, especially from difficult patients such as squirming infants, restless adults, and oldsters with fragile, rolling veins.

Since a separate vacuum tube has heretofore been required for each successive blood sample drawn from the same patient, tension and other forces applied to the hypodermic needle or to the catheter when held by one hand of the technician while withdrawing the delivery needle from the test tube with the other hand, as in the procedure of changing from one test tube to another, such forces transmitted through the catheter to the venipuncture aggravates patient responses above referred to and in some instances to the extent of stopping blood flow prematurely.

To obviate these conditions, the objects of the present invention are:

1. To provide a flexible catheter with a venipuncture needle in open communication with one end thereof and the opposite end of the catheter in communication with a distributor in the form of a sealed disc or closure for a container for a plurality of test tubes to be dealt with.

2. To provide a tubular member in open communication at one of its ends with the catheter intermediate the ends thereof with the opposite end of the tubular member in communication with a chamber for generating and/or holding a vacuum derived from any suitable source of supply.

3. To provide a first solenoid-actuated control valve associated with the catheter between the free or venipuncture end thereof and the point of connection between the catheter and the tubular member.

4. To provide second and third solenoid-actuated control valves operable within the length of said tubular member.

The foregoing and other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed. Reference being had to the accompanying drawings forming a part hereof and in which:

FIG. 1 is a side elevational view of apparatus made in accordance with our invention with some fragments broken away for convenience of illustration.

FIG. 2 is a top plan view of a test tube container.

FIG. 3 is a side elevational view of FIG. 2 with fragments broken away and parts in section for convenience of illustration.

FIG. 4 is a top plan view of FIG. 1.

FIG. 5 is a plan view of a vacuum pump and modified form of piston actuating means therefor.

FIG. 6 is a view similar to FIG. 3 showing a modified form of test tube container, and

FIG. 7 is a diagrammatic view of a flexible catheter, solenoid-actuated valves associated therewith and a wiring diagram for the solenoids and for a pump motor.

Referring now more particularly to the drawings wherein like reference numerals designate like parts and particularly FIGS. 1 and 4 thereof, numeral 1 indicates generally a base whose front portion is of channel section as indicated at 2. One end of a flexible catheter 3 extends into the channel 2 and by means of a coupling 3A is removabley secured to a tubular extension 4 which is connected to one end of a pipe 5 whose opposite or top end is in open connection as at 6 (FIG. 1) with the interior of a vacuum pump cylinder 7. A piston 8 operable within the cylinder 7 has an outwardly extending connecting rod 9 which terminates in a gear rack 10 engaged at all times with a driving spur gear 11. Gear 11 and a companion gear 12 (FIG. 4) are secured as at 13-14 to a common shaft 15 journaled in bearings 16-17 carried by brackets 18-19 secured as at 20-21 to a platform 22 secured in any suitable manner to the top surface of the base 1.

Both gears 11-12, and hence the gear rack 10, are driven by spur gear 24 enmeshed with the gear 12 and secured as at 25 to one end of a shaft 26 journaled in one bearing 27 carried by a bracket 28 and in another bearing 29 carried by a bracket 30. A worm wheel 34 is secured, as at 35, to the shaft 26 and is driven by a worm gear 36 secured as at 37 to the power output shaft 38 of a high torque reversible electric motor 39 secured in any suitable manner, such as at 40, to the platform 22.

With reference to the modification shown in FIG. 5, I dispense with the train of gears 12, 24, 36 and 34, and instead provide a direct driving connection between a spur gear 45 and the gear rack 10 by securing gear 45 to the motor output shaft 38 of the high torque motor 39 which is also reversible. In this modification, I also dispense with the platform 22 by bolting the motor 39 and pump cylinder 7, as at 39A, direct to the base 1. Shims can be used if necessary to elevate the motor 39 for proper engagement of its spur gear 45 with the gear rack 10.

From the foregoing, it will be apparent that operation of either motor 39 will, through the medium of its respective spur gears 24 or 45 and gear rack 10, pull a vacuum within the pump cylinder 7.

As best illustrated in FIG. 1, the free end of the catheter 3 is provided with a venipuncture needle 46 which after insertion in the selected vein in the patient's arm, as shown, may be held in a fixed position by surgical tape or the like as indicated at 47.

Within the channel 2 of the base 1, the opposite end of the catheter 3 is in open communication through a T-fitting 48 with the bottom end of a flexible tube 49 whose top end is fitted to and in open communication with an inlet tube 50 (FIGS. 2-3) of a distributor cap indicated generally at 52 for a test tube container indicated generally at 54. The cap is made of two parts 55-56 bonded together in any suitable manner.

The catheter 3 extends from the T-fitting 48 through a removable coupling 3A and from there into open communication with one end of the tubular extension 4 which is of slightly larger diameter than the catheter 3. The opposite end of the extension 4 is in open communication with the pipe 5 and hence the interior of the pump cylinder 7.

With further reference to the distributor cap 52 (FIG. 3) it will be noted that the bottom of the top part 55 is in open communication with a sump 57 in the bottom part 56 and with radially extending ducts 58 which terminate in downwardly extending delivery tubes 59 adapted to discharge pre-determined amounts of blood into the test tubes 63. It will also be noted that the top part 55 of cap 52 extends above the top of the container 54 for convenience in removing the cap to gain access to test tubes 63. The tubes are supported within upwardly opening cavities 65 formed in the relatively thick bottom wall 65A of the container.

The interior of the container 54 is shouldered as at 61 to provide a seat for the cap 52 and an annular seal 66.

In the modified form of tube container 54A (FIG. 6), the test tubes 63 are supported by means of similar cavities 66 formed in a movable disc 67 resting upon and movable upwardly by a cam 68 secured to a shaft 69 journaled in a bearing 70 on the interior of the chamber, extending outwardly therefrom and provided with a finger grip 72.

With reference to FIG. 4 and the wiring diagram associated therewith as illustrated in FIG. 7, we provide first, second, and third solenoid-actuated control switches 80, 81 and 82 respectively, which are mounted upon the covered portions or lid of the container 2. The channel 2 with one of the sides connected to one side 84 of electrical current by means of conductors 85, 86 and 87.

The opposite side of each switch 80, 81 and 82 is connected respectively at 90, 91 and 92 to one side of companion solenoids 93, 94 and 95 whose opposite sides are connected respectively as at 96, 97 and 98 to the opposite side 84A of said current source.
One side of motor 39 (FIG. 7) is connected by a conductor 99 to one side of a motor switch 100, whose opposite side is connected as at 101 to the side 84 of the current source.

The solenoids 93, 94, 95 are provided with armatures indicated at 104, 105 and 106, normally in a retracted position and out of contact with the underlying catheret 3 as shown at 105 and 106 in FIG. 7 by de-energization of their respective solenoids. Energization of any selected solenoid, for example the one indicated at 93, by closure of its respective switch 80 will forcefully thrust its armature 104 downwardly onto the catheret 3 against the bottom wall 108 of the channel 2 and thus effectively seal the catheret at that point against passage of vacuum or fluid therethrough in either direction.

With the various components of the apparatus set primarily in an operational position, for example as shown in FIG. 1, with the first solenoid control valve 80 closed as in FIG. 7, and the second and third solenoid actuated values 81 and 82 respectively, open, it will be apparent that operation of motor 39, upon closing motor switch 100, the resultant vacuum generated by the piston 8 of pump 7 will travel through the tubular extension 4 of the catheret, through the T-fitting 48, upwardly through tubular member 49 through the distributor cap 52 to the interior of the container 54 and the test tubes 63 supported within the container. Then making the venipuncture and closing the second and third valves 81–82 and opening the first valve 80 the vacuum in the catheret 3 will pull the blood from the venipuncture through T-fitting 48, tubular member 49, through distributor cap 52 to the interior of the container 54 and the test tubes 63 disposed therein as illustrated in dotted lines in FIG. 2. The amount of vacuum so utilized is calculated to be sufficient to fill all the tubes simultaneously to a level determined by the downward extent or depth of or insertion of the delivery tubes 59 into the test tubes 63.

At the conclusion of each blood drawing and distributing cycle the hypodermic needle 46 is withdrawn and the catheret removed from the patient's arm by removal of the surgical tapes 47. Following this the coupling 3A is removed to separate the catheter 3 from the extension 4 so that the catheret, T-fitting 48, tubular member 49, distributor cap 52, and the hypodermic needle may be disposed of to prevent further use on another patient.

When the distributor cap is removed from either form of test tube container the test tubes may be conveniently removed by grasping the top free end of the exposed tubes as in FIG. 3 or their elevated ends as in FIG. 6.

What we claim is:
1. Apparatus for drawing and controlling blood flow from a single venipuncture to multiple test tubes within a vacuumized container, comprising in combination, a base, vacuum supply means carried by said base, a flexible catheret extending along the base and in open communication at one of its ends with said vacuum supply, said catheret extending outwardly from said base and terminating in a hypodermic needle, a test tube container carried by said base and normally sealed by a distributor cap, a plurality of switch controlled valve members carried by said base and selectively operable to close the catheret at intervals lengthwise thereof, a bypass comprising a tubular member in communication at one of its ends with said catheret between two of said valve members and at its opposite end with said distributor cap and through the cap with the interior of said container and with test tubes contained within the container.

2. Apparatus as claimed in claim 1, wherein said vacuum supply means comprises a motor driven vacuum pump mounted on said base, said valve members include electrically actuated plungers superimposed said catheret within the base and controlled by switch means in circuit with said electrically actuated plungers mounted on the top surface of said base and in circuit with a source of electric current.

3. Apparatus as claimed in claim 1 wherein said distributor cap has concealed therein radially extending ducts in open communication at their inner ends with a downwardly open inlet tube extending upwardly from the center of the cap, and wherein the outer ends of said radially extending ducts are in open communication with downwardly extending delivery tubes adapted for insertion into test tubes disposed within said test tube container.

4. Apparatus as claimed in claim 1 wherein said test tube container has a relatively thick bottom wall having upwardly opening test tube supporting recesses therein.

5. Apparatus as claimed in claim 1 wherein said test tube container has an internal false bottom in the form of a disc having upwardly opening test tube supporting recesses therein, and wherein said disc rests upon and is movable upwardly and downwardly within the container by means of a cam secured to a shaft journaled within a bearing contained within the container and operable from the exterior thereof.

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