An infusion cannula for intravenous introduction of medical compounds into a patient. A catheter is engaged in a valve body having two inlets for connection to infusion fluid sources. On said inlet and the catheter are positioned such that the cannula may be introduced therethrough. A valve tap is sealingly and rotatably mounted in the valve body to permit introduction of infusion fluids through the catheter from either inlet of the valve body.

1 Claim, 11 Drawing Figures

FOREIGN PATENTS OR APPLICATIONS

1,024,410 3/1966 Great Britain 128/214.4
575,559 4/1924 France 128/214.4

Primary Examiner—Dalton L. Truluck
Attorney—Silverman & Cass

ABSTRACT
BACKGROUND OF THE INVENTION

The present invention refers to an infusion cannula assembly or intravenous catheter system in the form of a tap valve comprising a valve body having at least two inlets to which connection means for infusion fluids is sealingly engagable and an outlet to which a catheter means is sealingly engagable and which is so located with respect to one of the inlets that a cannula may be introduced through the valve and the catheter means, and a valve tap which is sealingly and rotatably mounted in the valve body and which is formed with passageways for the introduction of an infusion fluid through the catheter means from either of the inlets of the valve body.

Within the medical field treatments being used to an increasing extent according to which medical compounds are introduced into a patient intravenously or according to which samples of blood are taken at short intervals. Consequently the patient is often supplied with blood or infusion fluids on several occasions within fairly short periods of one or two days up to several weeks. In order to avoid too many punctures of the vein of the patient with all problems and disadvantages involved therein it has been common, after an intravenous infusion of some fluid into the patient, to leave the infusion cannula within the patient in order that this might be utilized for any subsequent infusion of the same or another fluid.

The infusion cannula is usually made of steel or any other rigid material and it is therefore of the greatest importance that the part of the body into which the cannula has been introduced and left is not bent since in that case pains and injuries may arise to the patient. In order to prevent such bending of said part of the body, usually the arm, this is often strapped to a sheet of wood or any other non-bendable material. This is irritating and sometimes painful to the patient and there has therefore been a need for a cannula assembly for infusion purposes where the cannula may be left within the patient during long periods without causing the patient discomfort or pains. There has thereby also been a desire that the cannula assembly should be so formed that one and the same cannula might be used for infusing various fluids alternatively or at the same time.

Various types of such infusion cannula assemblies have been proposed but none of said cannula assemblies proposed up till now have satisfied all of the demands for a functional such cannula assembly which achieves the above objects. One prior art cannula assembly is formed as a three-way-valve having a cylindrical hollow body valve into which a valve tap is introduced. The valve means is thereby so formed that two infusion fluids may be introduced alternatively or at the same time. This prior art structure, however, has a serious inherent disadvantage in that the valve tap running straight through the hollow cylindrical valve body cannot, without great difficulties, be completely sealed. A risk thereby arises in that air is forced into the valve and is brought into the vein of the patient whereby air embolism or other complications may result.

Another prior art infusion cannula assembly is likewise formed with a tap valve to which a catheter means of a non-bendable material is engagable. In this structure a cannula of steel or any other suitable material may be brought through the valve and so far through the catheter that the point of the cannula projects somewhat outside the mouth of the catheter. At the introduction of said infusion arrangement into the vein of the patient the cannula will thereby puncture the vein whereupon the catheter which closely surrounds the cannula may be introduced into the vein. When the catheter is thus positioned in the vein the cannula is retracted and the valve means is thus connected to the blood system of the patient over the bendable catheter.

The bendable catheter causes the patient very little discomfort and blood or alimentation fluid may easily be supplied to the patient alternatively or at the same time by means of the three-way-valve. However, the risk of leakage and a consequent risk of air embolism or other complications have not been overcome by this structure.

Further, it often is desired to supply some further fluid to the patient, for instance some injection fluid intravenously, and it is therefore desirable that said further fluid may be supplied to the patient in a strictly predetermined amount by means of the infusion arrangement described. In such a proposed arrangement, the valve means has been provided with a bore entering into the catheter passage way and which has been sealingly closed by means of a rubber mass. Upon intravenous injection, the point of an injection syringe is forced through said rubber mass into the catheter passageway whereupon the fluid is injected into the patient. Introduction of the syringe point may, however, tear particles of rubber away from the sealing rubber mass and thereby risk arises that such rubber particles may be introduced into the blood system of the patient.

SUMMARY OF THE INVENTION

It is an important object of this invention to provide an infusion cannula assembly, some part of which may, without any substantial discomfort for the patient, be left in the body of the patient, and which is provided with valve means which will enable at least two various infusion fluids to be supplied alternatively or at the same time to the patient. The invention also has as an important object the provision of an infusion cannula assembly in which the valve means as a whole is completely an tight and which is so constructed that blood, alimentation fluid or any other kind of infusion fluid may be introduced into the patient without the risk that air shots or undue particles may be introduced into the blood system of the patient.

Further objects of the invention will be evident from the appended claims and the following detailed description of the preferred embodiments of the invention whereby reference will be made to the accompanying drawings. It is however to be understood that the invention is not limited to the embodiments thus described and shown but other modifications may be presented within the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of one embodiment of an infusion cannula assembly constructed in accordance with the invention, the same being shown, for the sake of clarity, in split projection.

FIG. 2 is a sectional view taken along the line II—II of FIG. 1 in the direction indicated generally.

FIG. 3 is a bottom plan view of the valve tap of the invention.

FIG. 4 is a cross-sectional view similar to that of FIG.
2 but showing a modified embodiment of the invention.

FIGS. 5a and 5b are enlarged sectional views of the valve diaphragm illustrated in FIG. 4.

FIGS. 6a to 6e are schematic views illustrating operation of the invention in the various positions of the valve thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The infusion cannula assembly constructed according to the invention comprises a tap valve 1 having a cannula-catheter means 2 attachably connected thereto.

The tap valve comprises a valve body 3 having a valve tap fit therein. The valve body 3 includes a cup-formed part 5 open at the top and having two inlet nozzles 6 and 7 for infusion fluids and outlet nozzle 8 for connection with the cannula-catheter means 2. The cup-formed part 5 of the valve body is closed at its bottom and the three-connection nozzles 6, 7 and 8 extend radially out from the valve body part 5 adjacent to the bottom thereof and they are spaced 90° with respect to each other with the inlet nozzle 6 and the outlet nozzle 8 located diametrically opposite to each other. The inlet nozzles 6 and 7 are substantially cylindrical and are formed with an inner bore 9 which is of reduced diameter and conically shaped at the inner part thereof and which opens to the inner and lowermost part of the cup-formed valve body part 5. The inlet nozzles are further formed with a flange 10 on the outer ends thereof. The flange 10 is of generally square shaped configuration with the outside dimension thereof being slightly greater than the outer diameter of the cylindrical part of the nozzle. The purpose of the flange 10 is to serve as a holder means for a protection cup for the inlet nozzles as will be further explained below.

The outlet nozzle 8 tapers outwardwards for enabling a conical clamping of the cannula-catheter means to provide a good seal. For the purpose of preventing the cannula means 2 and the valve body 1 from unintentionally disengaging, and for establishing a labyrinth seal therebetween the outlet nozzle is formed with an annular bulge 11 adapted to be sealingly engaged with a corresponding annular groove 27 of the cannula means 2. The outlet nozzle 8 further is formed with a bore, opening into the inner and lowermost part of the valve body. It is important that the bores of the inlet nozzle 6 and the outlet nozzle 8 are extending in alignment with each other for enabling thereby an introduction of a cannula straight through the whole of the valve body and the two nozzles as will be further explained below. In its bottom the valve body is formed with a frustoconical extension 12, the purpose of which is to stabilize and centre the low part of the valve tap and to establish a sealing clamping of the walls thereof against the inner walls of the valve body. The valve body is formed with an annular groove 13 at a point somewhat above the bores 9 of the connection nozzles, the purpose of which is both to prevent the valve tap and the valve body from unintentionally separating, and to establish a labyrinth-like seal therein in order to eliminate the risk of leakage. In order to further increase the sealing between the valve tap and the valve body, the valve body is formed, in the uppermost part thereof, with a bevel 14 diverging toward the top, and the valve tap 4 is formed with a corresponding bevel.

The valve tap 4 is substantially cylindrical and a lower part thereof forms the actual valve means while the upper part thereof is formed as a handle 15 having three handle pins. The handle pins are disposed radially and perpendicular to each other and the purpose thereof is to enable the handle pins to serve as an indicator of the fluid direction through the valve. The positions of the handle pins consequently correspond to the location of the inlet nozzles 6 and 7 and the outlet nozzle 8. The valve tap 4 is formed in the lower part thereof with an axial bore 16 extending somewhat upwards, and the valve wall is intersected by three radial slots 17 extending from the bottom of the valve tap to a point in line with or slightly above the upper edge of the inlet passageways of the connection nozzles 6, 7 and 8 into the valve body. The slots 17 are provided normal to each other and in axial alignment with the handle pins of the handle 15. The valve tap is formed with an annular bulge 18 adapted to matingly engage annular groove 13 in valve body 3. The valve tap 4 also includes a bevelled part 19 adapted to mate with bevel 14 of the valve body.

Both the valve tap and the valve body are preferably made of some resilient material and a suitable material for this purpose has shown to be thermoplastic resins such as resins of the group of resins named polyamide plastics, ethene plastics, tetrafluoroethylene plastics or the like. Such synthetic resins possess the advantage of both being somewhat resilient and having self-lubricating properties and hence there is no need that the valve tap will get stuck in the valve housing even if it is clamped fairly tightly therein.

The mounting of the valve tap in the valve body is accomplished by forcing the valve tap, with suitable pressure, axially into the valve body until the annular bulge 18 has come into position in the corresponding annular groove 13 of the valve body.

In a preferred embodiment of the invention the bores 9 of the inlet nozzles 6 and 7 are formed with a size and a draught corresponding to the general standard, whereby ordinary needles, syringes and the like may be used in connection with the cannula assembly.

The cannula-catheter means 2 includes a catheter 22 and a connection bracket 23, into which catheter may be inserted a standard pointed cannula 20 of steel or a similar material provided with a connection tube 21.

As stated above the cannula 20 is of standard construction and may have any suitable size. The cannula 20 is cast into or glued to the connection tube 21, and the fluid passageway of the cannula opens in a corresponding bore 24 of the tube 21. In order to establish a good seal between the cannula and the valve body, the cannula connection tube 21 is formed with a tapered part 25 adapted to engage the corresponding tapered part of the inlet nozzle 6. No snap locking means such as that provided in the outlet nozzle is present at the inlet nozzle 6, since this would obstruct the removal of the cannula 20 after insertion of the catheter 22 into the vein of the patient.

The catheter 22 which is constructed of a thin wall tube of a flexible material preferably polytetrafluorethene (TEFLOM) or polyethylene, is sealingly attached to the connection bracket 23. The size of the catheter should be adapted to the size of the cannula 20, so that said cannula 20 may be introduced through the catheter 22 in sealing engagement therewith but without difficulty. The catheter passageway opens into a passage-
way 26 of the connection bracket 23 and said passageway is enlarged near the valve to form a tapered passageway adapted to matingly engage the outlet nozzle 8. Passageway 26 is formed with an annular groove 27 corresponding to the bulge 11 of the outlet nozzle 8. The connection bracket 23 is further formed with a pair of curved wings 28 by means of which the cannula assembly may be attached for instance to the arm of a patient by means of plaster or the like.

The cannula-catheter means 2 may be connected to the valve 1 by forcing the connection bracket 23 axially against the outlet nozzle 8 of the valve until the bulge 11 engages the groove 27. The valve tap 4 is adjusted for straight line flow through the valve, i.e., as indicated in FIG. 6d, and the cannula 20 is introduced through the inlet nozzle 6, the valve body 5, the outlet nozzle 8, the connection bracket 23 and the catheter 22. In its fully inserted position, the cannula will project a small distance out of the catheter 22. For facilitating the insertion of the catheter into a vein which has been punctured by the cannula, the outer end thereof is bevelled to the cannula. Preferably said bevelled outer end of the catheter 22 is somewhat shrunk to assure a good seal between this part of the catheter and the cannula.

When the infusion cannula of the invention is inserted into a vein of the patient, the part of the cannula 20 projecting outside the catheter 22 will puncture the vein, and as the cannula is further inserted, the catheter 22 will be forced into the vein. In order to avoid waste of blood or the like, the connection tube 21 of the cannula is preferably formed with a receptacle for blood (not indicated in the drawings). Such a receptacle may for instance be a plastics bag or the like which has been tied around the connection tube. As soon as the catheter is in its proper place, the cannula may be retracted and the valve is closed, i.e., the valve tap is turned one eighth of a full turn in the clockwise direction so as to take the position indicated in FIG. 6e. Thereafter connection means for blood may be connected for instance to the inlet nozzle 6 and connection means for infusion fluid or the like to the inlet nozzle 7. When the patient is to be supplied with blood, the valve tap is turned to the position indicated in FIG. 6d, and when the patient is to be supplied with infusion fluid the valve tap is turned to the position indicated in FIG. 6a. The valve assembly also offers the possibility of introducing blood and infusion fluid at the same time into the patient and in such case the valve tap is turned into the position indicated in FIG. 6b. Thereby blood and alimentation fluid will be supplied at the same time through the catheter 22 after having been mixed in the valve body 5.

The position indicated in FIG. 6e is used mainly for washing or cleaning of the valve and the inlet nozzles 6 and 7. Of course, blood or alimentation fluid may be supplied through either of the inlet nozzles 6 and 7. It is to be noted that the cannula assembly causes the patient very little discomfort since the catheter 22 is made of a flexible material. Even if the cannula assembly is left attached to the arm or other part of the patient, it does not to any greater extent impede the movements of the patient and therefore the cannula assembly may without any greater disadvantages be left attached to the patient during a period of several weeks.

When the supply of blood and/or alimentation fluid ceases the valve tap is turned as indicated in FIG. 6e, so that the various flows through the valve cease. In certain cases it may hereby be suitable to wash the valve body clean and this is possible by adjusting the valve tap as indicated in FIG. 6e as mentioned above. For protecting the inlet nozzles 6 and 7 against impurities when blood or alimentation fluid is not supplied, the nozzle assemblies are provided with protection caps 29 one of which is best shown in FIG. 4. The protection cap 29 is formed with an inner tap 30, which is slightly tapered like the bore 9 of the inlet nozzle 7. When the cap 29 is mounted on the inlet nozzle, the nozzle is sealed very effectively and at the same time the outer surfaces thereof are protected by the jacket of the cap.

Often it is desired to supply some further form of infusion fluid to the patient by the cannula assembly and this may easily be done by means of a syringe, for instance the syringe 31 indicated by the dotted lines in FIG. 2 which may be connected directly to either of the two inlet nozzles without the need for a syringe needle.

Sometimes it may, however, be desired to give the patient, in addition to blood and alimentation fluid, a third infusion fluid at the same time. For this purpose the embodiment of the invention shovld in FIGS. 4 and 5 is well suited. From FIG. 4 it is evident that the valve tap 4 is formed with an axial cavity 16 and in the upper part of said cavity a valve diaphragm 32 of rubber or a similar material is mounted. The valve diaphragm 32 is in sealing engagement with the hole 16 of the valve tap 4 and it is formed with a radially projecting flange 33 adapted to engage the upper edge of the valve tap 4. A thin and narrow cut 34 has been made in the lowermost part of the valve diaphragm. The cut 34 is sufficiently narrow and thin so as to completely seal against penetration of air, fluid or particles into the inner parts of the valve at normal pressure from the outside. The upper part of the bore 16 may, like the diaphragm 32, be made according to any suitable standard in order that a syringe without cannula may be connected to the inner parts of the valve diaphragm 32 with a good seal.

The valve diaphragm 32 will thereby form an injection valve. FIG. 5a shows the action during an injection through the valve diaphragm 32 and FIG. 5b shows the function at infusion through the inlet nozzles 6 and 7. Thus, when the syringe has been connected to the valve diaphragm 32 and the injection fluid is forced towards the inner part of the valve diaphragm, the lower cup-formed part thereof is forced to widen somewhat, whereby the cut 34 opens and permits the injection fluid to enter the valve. As soon as the pressure from the syringe ceases, the cut 34 recloses and prevents further injection fluids from passing into the valve and blood and infusion fluid from escaping from the valve to the valve diaphragm 32.

In instances where only the inlet nozzles 6 and 7 are used for the infusion, the illustration of FIG. 5b is present, whereby the fluid under pressure existing within the valve will cause a pressure upwards in the direction of the arrow against the cup-formed part of the valve diaphragm. This cup-formed part will thereby become somewhat compressed by a pressure which will increase as the pressure on the fluid within the valve rises. This prevents leakage even at fairly high pressures within the valve. In FIG. 5b the normal position of the valve diaphragm has been indicated by dotted lines, while its pressure actuated position has been indicated by continuous lines. Preferably also the valve diaphragm 32 is provided with some form of protection
means known per se for preventing emptying of the valve diaphragm when no injection takes place.

It will be obvious to a person skilled in the art that the invention may be modified in many various ways by replacing various parts by equivalent parts or by adapting the arrangement to various alternative purposes without departing from the spirit or scope of the invention.

What we claim is:

1. An infusion cannula assembly comprising, a threeway valve including a valve body having at least two inlet openings for introduction of infusion fluids and an outlet opening, the openings being disposed radially normal with each other, one of said inlet openings being positioned along a line common with said outlet opening, a catheter sealingly engaged on said outlet opening, the catheter including a connection bracket having a pair of arcuate wings formed integral therewith, a cannula having a puncturing point at one end and a cannula connection tube at the other end, said cannula remotely received through said one inlet opening and said catheter, said valve body being of generally cup-shaped configuration with an open top, a valve tap of generally cup-shaped configuration with an open top and bottom, the valve body having a raised extension formed in the bottom thereof defining an annular groove between said extension and the walls of the valve body, said valve tap being sealingly and rotatably mounted in the open top of the valve body with the open bottom of the valve tap disposed within the valve body, the bottom of the valve tap being positioned in said groove to be guided thereby, said valve tap including gate-formed slots opening to the bottom thereof to permit selective introduction of infusion fluids from either or both of said inlet openings, the valve tap including a handle with three radially outstanding pins disposed in corresponding arrangement with said slots such that the disposition of the slots and the resultant flow through the tap valve is indicated by said pins, the valve tap forming a mixing chamber within the valve body, said valve tap including a resilient diaphragm positioned over the top thereof and extending therewithin, said diaphragm having a narrow slit on the portion thereof extending within the valve tap, whereby infusion fluids may selectively be introduced under pressure into said assembly through said diaphragm independent of the disposition of the slots in said valve tap, but said diaphragm will otherwise maintain an air-tight seal of said valve tap on said assembly, and annular bulge and groove means positioned between said valve body and valve tap and between said catheter and said outlet opening such that an air-tight seal is formed therebetween to prevent inadvertent entry of air into said assembly.

* * * * *