March 21, 1967 D. E. EWING 3,310,048

EXSANGUINATION VALVE

Filed Dec. 17, 1963 2 Sheets-Sheet 1

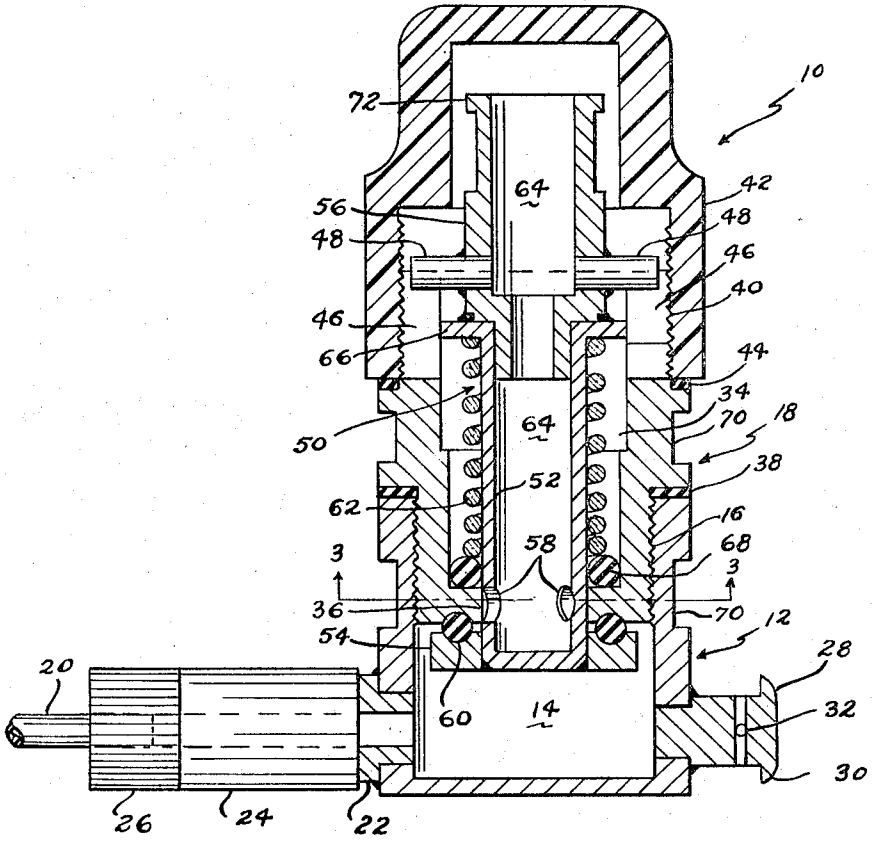

Fig-1

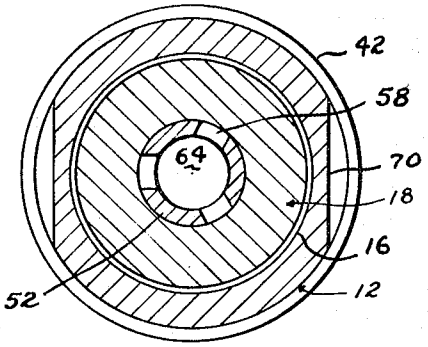

Fig-3

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EXSANGUINATION VALVE

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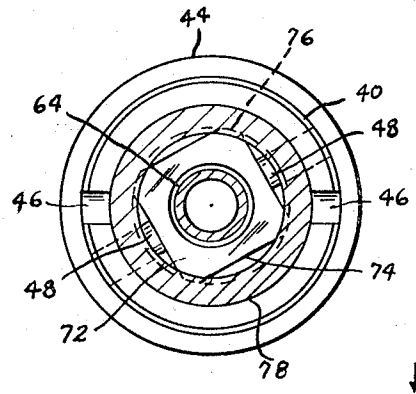

Fig-4

Fig-2

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3,310,048

EXSANGUINATION VALVE

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13 Claims. (Cl. 128—2)

The invention described herein may be manufactured by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to fluid valves and, more specifically, to a small fluid valve filling a need for an exsanguination valve suitable for use in the conduct of medical experiments where it is desired to take blood samples over a prolonged period of time from the same test subject. The valve to be described hereinafter has been successfully employed on animals, such as dogs, undergoing medical research in connection with toxicity and other environmental conditions encountered in space flight.

Many of the environmental conditions encountered on space flights produce adverse effects, or effects which must be controlled in living bodies accustomed only to the earth's atmospheric environment. In addition to the effect of an unnatural environment, other factors, such as a change in diet, influence body chemistry.

Many environmental factors under investigation influence the blood; and repeated blood samples are taken from the subject undergoing test. These blood samples in some cases may be taken as often as one every five minutes; or, they may be taken at say one a day for a period of several months. For convenience, and for the comfort of the animal undergoing the test, the valve of this invention is sutured to the skin of the animal, or is strapped to the animal's neck; and a small polyethene catheter tube, extending from the valve, is inserted into the vascular system of the animal. The valve and catheter tube are left in place during the entire test program; after which they are removed. The installation on the animal has been found to produce no discomfort and the animal becomes oblivious to the installation.

The exsanguination valve is designed for use with standard syringes such as a "Hypo" syringe No. PV189 furnished by the Surgical Supply Corporation; and is well known to the medical and veterinary professions. As will be explained hereinafter, in use, the syringe is removably joined to the valve in a leakproof manner and actuates the valve.

The valve to be disclosed is quite small and lightweight, being about one and one-quarter (1¼) inch in length and one-half (½) inch in diameter. It may be made of materials such as stainless steel and plastics which are inert to the body fluids with which the valve comes into contact.

One object of the present invention is to provide an exsanguination valve which is extremely small and lightweight in order that it may be worn by small animals for prolonged periods of time without awareness or discomforture.

Another object of the present invention is to provide an exsanguination valve which may be joined to an animal undergoing physiological test, in order to eliminate the need for making a needle puncture each time a blood sample is withdrawn.

A further object of the present invention is to provide an exsanguination valve through which not only blood samples may be withdrawn, but through which fluids may be injected into the bloodstream without each time making a needle puncture.

Yet another object of the present invention is to provide an exsanguination valve in which all operating elements may easily be replaced as a sub-assembly without removing the valve from the subject undergoing test.

Additional objects, advantages and features of the invention reside in the construction, arrangement and combination of parts involved in the embodiment of the invention as will appear from the following description and accompanying drawings in enlarged scale, wherein:

FIG. 1 is a vertical cross section of the exsanguination valve in the normally closed position with the removable dust cap in place;

FIG. 2 is a similar cross section of the valve, in the open position, with the dust cap removed and the syringe engaging the valve,

FIG. 3 is a horizontal cross section along line 3—3 on FIG. 1; and,

FIG. 4 is a horizontal cross section along line 4—4 on FIG. 2.

Referring to the drawings and, in particular, to FIG. 1 and FIG. 2, the exsanguination valve in its entirety will hereinafter be referred to as valve **10**. The valve **10** has a housing **12** having a cavity **14** which is closed at the bottom and has an open end at the top. The upper open end of cavity **14** is internally threaded to have threads **16** which engage like external threads on the lower end of valve seat member **18**. Radially extending from the lower portion of the housing **12** and communicating with the lower portion of cavity **14** is a means for attaching a catheter tube **20**. The means for attaching the catheter tube may be any of numerous well known elements such as the male tubing fitting **22** which threadably receives nut **24** to hold the catheter tube in leakproof engagement with the valve. The nut **24** may be made with serrations **26** to provide finger grips for easy actuation. The catheter tube may be of any diameter and length which are suitable for the particular application. Radiating from the lower portion of housing **12** are one or more tie down buttons **28** of any convenient size and form. The buttons illustrated have flanges **30** for retaining small straps or cords, and holes **32** for optionally retaining small wires. The valve **10** is preferably held in place on the neck of the test animal by means of skin sutures engaging the tie down buttons.

The valve seat member **18**, which is in threaded engagement with housing **12** so as to close the open end of the cavity in the housing, contains a coaxial cavity **34**, open at the upper or top end, and having at the opposite bottom end a closed end wall containing a coaxial circular passage **36** permitting communication between the cavity **34** in the valve seat member **18** and the cavity **14** in the housing **12**. A customary gasket **38**, to prevent leakage, is placed between the housing and the valve seat member as shown. The upper end of valve seat member **18** has external threads **40** for threadably engaging a dust cap **42** of any convenient form. The dust cap, when in place as shown on FIG. 1, effectively prevents dust and other contaminants from entering the valve and coming into contact with fluids passing through the valve. The dust cap is preferably made of plastic in order to have minimum weight. The dust cap seats against a ring gasket **44** as shown. The upper end of the valve seat member **18** further contains locking means for holding the valve in the open position. The means shown on the drawings consists of the well known bayonet lock and comprises two J-shaped slots **46** in the upper end of the valve seat member which slidably engages pins **48** joined to valve plug **50**.

Valve plug **50**, in its more essential elements, comprises an elongated cylindrical tube **52** closed at the lower end, a valve plug ring **54** coaxially surrounding and joined to the lower end of the cylindrical tube **52**, and a hollow syringe adapter **56** coaxially joined to the opposite open end of the cylindrical tube **52** to provide a valve plug hav-

ing a cavity open at the outer end and closed at the bottom inner end. The lower portion of the cylindrical tube **52** of valve plug **50** passes through the circular passage **36** in the lower end of valve seat member **18** and contains one or more ports **58** passing through the wall of the tube and axially located to be adjacent to the wall of the circular passage when the valve is in the normally closed position shown on FIG. 1. The upper face of valve plug ring **54** and the lower face of valve seat member **18** have mating arcuate circular grooves for engaging a first O-ring seal **60** as shown. When the valve plug is depressed against compression spring **62** to the open position shown on FIG. 2, ports **58** are in communication with cavity **14** in housing **12** and fluids may be transferred between the catheter tube **20** and the axial passage **64** within the cylinder tube **52** and syringe adapter **56**. The upper portion of cylindrical tube **52** terminates in a flange **66** which slidably engages the sidewall of cavity **34** in valve seat member **18** to provide guiding support to valve plug **50**.

The compression spring **62** is coaxial with the cylindrical tube **52** and disposed between the lower face of flange **66** and a second O-ring **68** which is coaxial with tube **52** at the bottom of cavity **34**. The bias of the compression spring holds the valve in its normally closed position. The primary purpose of O-ring **68** which is wedged at the bottom of cavity **34** in valve seat member **18**, is to prevent the passage of fluid between cavity **14** in housing **12** and cavity **34** in valve seat member **18** when the valve is in the open position.

For manufacturing convenience the cylindrical tube **52** and syringe adapter **56** are preferably made as separate pieces and then joined by welding or brazing as shown. On assembly of valve plug **50** with valve seat member **18**, the O-ring **68** is dropped into cavity **34** of the valve seat member, the spring is placed into position on circular tube **52** which is then passed through circular passage **36**, after which the valve plug ring **54** and O-ring **60** are placed in position as shown. The valve plug ring **54** may be joined to tube **52** by welding, brazing or other well known means. It is noted that all the working elements have been formed into an actuating assembly which may now be screwed into housing **12**. Should a leak develop while the valve is in use on an animal, the entire actuating assembly may be replaced with small open end wrenches engaging the wrench flats **70** on the body member **12** and valve seat member **18**. While one actuating assembly is being replaced by another actuating assembly, the catheter tube should be pinched closed, or other means used to prevent loss of blood from the animal.

The thin flange **72** at the upper open end of the syringe adapter **56** is formed in circular form on which flat sides **74** are then machined as shown on FIG. 4; leaving circular corners **76** which make threaded engagement with the metal lock end **78** on syringe **80**.

The valve is actuated from the normally closed to the open position and vice versa by means of the syringe itself. Referring more specifically to FIG. 2, after the dust cap has been removed, the syringe **80** is firmly screwed in place onto the syringe adapter as shown. The valve plug **50** is then depressed by pushing downward on the body of the springe which is then given a slight turn to hold the bayonet lock in the locked position. To close the valve the procedure is reversed. The body of the syringe is turned in the opposite direction to unlock the bayonet lock, the compression spring closes the valve, the syringe is unscrewed and the dust cap replaced.

In use, after blood has been withdrawn from the test subject into the syringe through the catheter tube and valve, the catheter tube and cavity within the valve are full of blood which, of course, should not be allowed to coagulate, but should be returned to the flowing blood stream of the animal. This may easily be accomplished by injecting into the valve the proper amount of heparin, or other suitable anti-coagulant to purge the cavity of the valve and catheter tube.

The following procedure has been found to be most satisfactory, using two syringes: The dust cap is removed and an empty syringe is screwed in place and the valve opened. The blood sample is then drawn into the syringe and the valve is closed. The syringe containing the blood sample is then removed. The second syringe, containing the proper volume of heparin is then screwed in place on the valve and the valve re-opened, after which the heparin is injected; purging the valve and catheter of blood. The valve is then closed, and the second syringe, which is now empty, is unscrewed and the dust cap replaced. The heparin remains in the valve and catheter until the next blood sample is to be drawn. A first empty syringe withdraws the heparin and a second syringe withdraws the blood sample.

It is obvious that techniques other than the one above described will be known to the profession. It is also obvious that fluids may be injected into the blood stream as well as withdrawn therefrom; and that the valve of this invention has wide application in many areas of physiological research.

It is to be understood that the embodiment of the present invention as shown and described is to be regarded as illustrative only and that the invention is susceptible to variations, modifications and changes within the scope of the appended claims.

I claim:

1. An exsanguination valve for joining to the blood stream of a test subject by means of a catheter tube and permitting the repeated withdrawal of blood samples with a syringe attachable to and detachable from said exsanguination valve comprising: a housing having a cavity open at one end and an inlet communicating with the cavity in said housing and joinable to said catheter tube, a valve seat member joined to said housing and closing the open end of the cavity in said housing and having a cavity open at one end and at the opposite end of said cavity having a closed end wall with a circular passage therethrough adjacent to the cavity in said housing, and a valve plug having a cavity open at the outer end and extending into an elongated cylindrical closed end tube passing through and axially movable in the circular passage in said valve seat member with the closed end extending into the cavity in said housing and having at least one port in the cylindrical tube of said valve plug axially located to be within the circular passage through the closed end wall of said valve seat member when said valve is in the normally closed position and further having an adapter at the open outer end of said valve plug for removably joining to said syringe permitting said valve plug to be axially moved to bring the ports in said valve plug in communication with the cavity in said housing permitting said syringe to withdraw blood through said valve and catheter tube from said test subject.

2. An exsanguination valve for joining to the blood stream of a test subject by means of a catheter tube and permitting the repeated withdrawal of blood samples with a syringe attachable to and detachable from said exsanguination valve comprising: a housing having a cavity open at one end and an inlet communicating with the cavity in said housing and joinable to said catheter tube, a valve seat member threadably joined to said housing and closing the open end of the cavity in said housing and having an axial cavity open at one end and at the opposite end of said cavity having a closed end wall with a circular passage therethrough coaxial with said axial cavity and adjacent to the cavity in said housing, a valve plug having a cavity open at the outer end and extending into an elongated cylindrical closed end tube passing through and axially movable in the circular passage in said valve seat member with the closed end extending into the cavity in said housing and terminating in a stop to limit in one direction the axial movement of said valve plug to the closed position in said valve seat member and further having at least one port in the cylindrical tube of said

valve plug axially located to be within the circular passage through the closed end wall of said valve seat member when said valve is in the normally closed position and further having an adapter at the open outer end of said valve plug for removably joining to said syringe permitting said valve plug to be axially moved to bring the ports in said valve plug in communication with the cavity in said housing permitting said syringe to withdraw blood through said valve and catheter tube from said test subject.

3. An exsanguination valve in accordance with claim 2 and further having:

a spring engaging and biasing said valve plug to the closed position in said valve seat member.

4. An exsanguination valve in accordance with claim 2 and further having:

a compression spring coaxial with the elongated cylindrical closed end tube on said valve plug and disposed between said valve plug and said valve seat member to bias said valve plug to the closed position in said valve seat member.

5. An exsanguination valve for joining to the blood stream of a test subject by means of a catheter tube and permitting the repeated withdrawal of blood samples with a syringe attachable to and detachable from said exsanguination valve comprising: a housing having a cavity open at one end and an inlet communicating with the cavity in said housing and joinable to said catheter tube, a valve seat member joined to said housing and closing the open end of the cavity in said housing and having a cavity open at one end and at the opposite end of said cavity having a closed end wall with a circular passage therethrough adjacent to the cavity in said housing, a valve plug having a cavity open at the outer end and extending into an elongated cylindrical closed end tube passing through and axially movable in the circular passage in said valve seat member with the closed end extending into the cavity in said housing and having at least one port in the cylindrical tube of said valve plug axially located to be within the circular passage through the closed end wall of said valve seat member when said valve is in the normally closed position and further having an adapter at the open outer end of said valve plug for removably joining to said syringe permitting said valve plug to be axially moved to bring the ports in said valve plug in communication with the cavity in said housing permitting said syringe to withdraw blood through said valve and catheter tube from said test subject, a spring engaging said valve plug and biasing said valve plug to the normally closed position in said valve seat member, and a seal disposed between said valve plug and said valve seat member to prevent leakage of blood from the cavity in said housing when said valve is in the normally closed position.

6. An exsanguination valve in accordance with claim 5 in which:

(a) the spring biasing said valve plug to the closed position is a compression spring coaxial with the elongated cylindrical closed end tube on said valve plug and disposed between said valve plug and said valve seat member, and

(b) the seal disposed between said valve plug and said valve seat member is an O-ring.

7. An exsanguination valve in accordance with claim 5 and further having:

a seal disposed between said valve plug and said valve seat member to prevent leakage of blood into the cavity in said valve seat member when said valve plug is displaced from the normally closed position.

8. An exsanguination valve in accordance with claim 5 in which:

(a) the spring biasing said valve plug to the normally closed position is a compression spring coaxial with the elongated cylindrical closed end tube on said valve plug and is disposed between said valve plug and said valve seat member, and

(b) the seal disposed between said valve seat and said valve seat member is an O-ring; and further having:

a seal coaxially surrounding the elongated cylindrical closed end tube on said valve plug to prevent leakage of blood into the cavity in said valve seat member when said valve plug is displaced from the normally closed position, said seal being an O-ring disposed between said compression spring and the closed end wall of said valve seat member.

9. An exsanguination valve for joining to the blood stream of a test subject by means of a catheter tube and permitting the repeated withdrawal of blood samples with a syringe attachable to and detachable from said exsanguination valve comprising: a housing having a cavity open at one end and inlet communicating with the cavity in said housing and joinable to said catheter tube, a valve seat member threadably joined to said housing and closing the open end of the cavity in said housing and having an axial cavity open at one end and at the opposite end of said cavity having a closed end wall with a circular passage therethrough coaxial with said axial cavity and adjacent to the cavity in said housing, a valve plug raving a cavity open at the outer end and extending into an elongated cylindrical closed end tube passing through and axially movable in the circular passage in said valve seat member with the closed end extending into the cavity in said housing and having at least one port in the cylindrical tube of said valve plug axially located to be within the circular passage through the closed end wall of said valve seat member when said valve is in the normally closed position and further having an adapter at the open outer end of said valve plug for removably joining to said syringe permitting said valve plug to be axially moved to bring the ports in said valve plug in communication with the cavity in said housing permitting said syringe to withdraw blood through said valve and catheter tube from said test subject, a valve plug ring coaxially joined to the closed end of the cylindrical tube of said valve plug extending into the cavity in said housing and cooperatively joining said valve seat member and said valve plug to limit in one direction the axial movement of said valve plug to the closed position in said valve seat member, a first O-ring seal coaxially surrounding the cylindrical tube of said valve plug and disposed between said valve plug ring and said valve seat member to prevent leakage of blood from the cavity in said housing when said valve is in the normally closed position, a compression spring coaxial about the cylindrical tube of said valve plug within the cavity in said valve seat member and having one end axially engaging said valve plug to bias said valve plug to the normally closed position in said valve seat member, a second O-ring coaxial about the cylindrical tube of said valve plug and disposed within the cavity in said valve seat member between the closed end wall of said valve seat member and said compression spring to prevent leakage of blood into the cavity in said valve seat member when said valve plug is displaced from the normally closed position, and a lock cooperatively joining said valve seat member and said valve plug to releasably hold said valve in the open position.

10. An exsanguination valve in accordance with claim 9 in which said housing has at least one tie down button protruding therefrom for removably joining said valve to said test subject.

11. An exsanguination valve for joining to the blood stream of a test subject by means of a catheter tube and permitting the repeated withdrawal of blood samples with a syringe attachable to and detachable from said exsanguination valve comprising: a housing having a cavity open at one end and an inlet communicating with the cavity in said housing and joinable to said catheter tube,

and an actuating assembly threadably joined to said housing to close the open end of and be in communication with the cavity in said housing, said actuating assembly having a valve seat member, a valve plug actuatable to an open and a closed position in said valve seat member, and a spring biasing said valve plug to the closed position in said valve seat member, said valve plug having passage means for receiving blood from the cavity in said housing when said valve is in the open position and terminating in an adapter for removably joining to said syringe with the passage means in said valve plug in communication with said syringe permitting said valve plug to be actuated to the open position by said syringe thereby allowing withdrawal of glood into said syringe through said valve and catheter tube from said test subject.

12. An exsanguination valve in accordance with claim **11** in which said spring is a compression spring.

13. An exsanguination valve in accordance with claim **11** in which said spring is a compression spring, and further having:

(a) at least one tie down button protruding from said housing for removably joining said valve to said test subject, and

(b) a lock cooperatively joining said valve seat member and said valve plug to releasably hold said valve in the open position.

References Cited by the Examiner

UNITED STATES PATENTS

2,083,571	6/1937	Barks	141—348 X
2,574,022	11/1951	Dahl	141—348 X
2,699,776	1/1955	Alexander	128—214
2,728,509	12/1955	Peterson	141—349
3,024,044	3/1962	Benevento	284—19
3,043,303	7/1962	Still	128—214
3,181,529	5/1965	Wilburn	128—2

FOREIGN PATENTS

811,482	1/1937	France.

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