

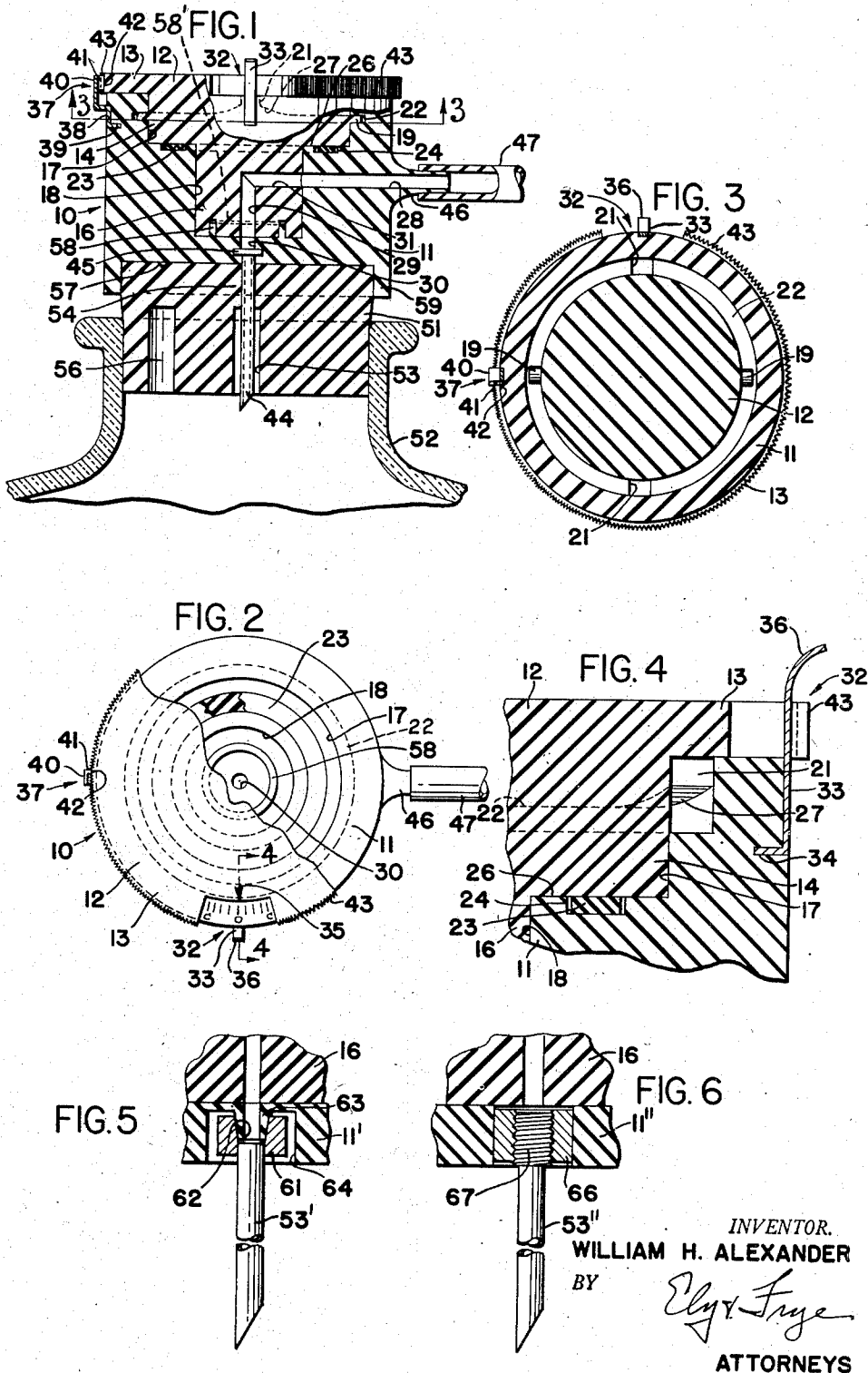
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VALVE FOR SURGICAL APPLIANCES

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VALVE FOR SURGICAL APPLIANCES

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This invention relates to a valve, and particularly to a valve for use in the transfer of blood to containers. Although valves have been proposed for this use, they have been complex and prohibitively costly, and cleaning for re-use has been difficult if not impossible. As a consequence, it is still customary in the art for the suppliers of tubing and other items involved in blood transfer to include a simple disc of thin gauge metal, which the user bends about the tubing to crimp it and thus meter the flow or stop it entirely, as required. In an otherwise highly developed art, this expedient seems crude by comparison and leaves much to be desired.

For example, in the transferring of blood from a donor to a container, the latter is in a condition of vacuum. When the transfer mechanism is set up, the tubing is pinched off by the piece of bent sheet metal. Transfer is begun by manipulating the clamping metal to provide passage for the blood through the tube. Fine regulation is next to impossible and the result is a surging into the low pressure region in the container. This may have serious consequences, for if blood is drawn too fast from a donor, collapsing of a blood vein may result. At present, there is no adequate way of estimating blood flow except by counting drops thereof. The difficulty of manipulating the flow control is increased by the fact that the operator or attendant has several things demanding the attention of his senses.

By the present invention these difficulties are overcome in the provision of a rotary valve which is simple and inexpensive of manufacture, which is capable of fine regulation and sure action by any operator with a minimum of direct attention, and which may be easily cleaned and sterilized for re-use.

It is, therefore, an object of the invention to provide a rotary valve for transfer of blood or other fluids in the surgical art, which is easily operated and certain in action, and which requires a minimum of attention on the part of an operator. Other objects are to provide a valve of this nature which is simple and inexpensive of manufacture and which may be easily cleaned and sterilized for re-use.

The foregoing objects are attained by the valve of this invention, a preferred form of which is described in the following specification and illustrated in the drawings, in which:

Fig. 1 is an axial sectional view of the valve mounted on the stopper of a vacuum bottle, with a fragmentary portion of the valve shown in elevation,

Fig. 2 is a top plan view of the valve, with the rotor broken away in part,

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1,

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 2,

Fig. 5 is a fragmentary view of a portion of the valve, showing a modified needle mounting, and

Fig. 6 is a view similar to Fig. 5, showing a further modification.

Referring to the drawings by characters of reference, there is shown generally, by the numeral 10, a valve body comprising a hollow base member 11 in which is fitted a rotor 12. The latter has an upper flange 13, a first, reduced, cylindrical portion 14, and a second, reduced, cylindrical portion 16 forming the lowermost end of the rotor. The said reduced portions are respectively received in complementary cavities 17, 18 in the base 11.

Parts 11 and 12 are held together by a bayonet type

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joint consisting of diametrically opposed, pin-like elements 19, integral with cylindrical portion 14, which are slidable axially of the valve in a pair of vertical grooves 21 in the wall of cavity 17, and circumferentially in an annular groove 22 in the same wall, the latter groove being in communication with the bottom of the said vertical groove.

An air seal is provided in the contacting areas of parts 11 and 12 by a soft rubber ring 23 seated in an annular groove or channel 24 in the shoulder 26 between cavities 17 and 18. When uncompressed, the rubber ring 23 has a thickness slightly in excess of the depth of channel 24, and also has a width less than that of the channel, so that when the parts are brought into contact, the rubber ring is compressed to seal off the valve against passage of air. The required degree of compression is not great and, therefore, the frictional resistance to rotation of part 12 is not excessive. In order to provide gradual compression of the sealing ring, the upper wall of the annular groove 22 adjacent to and on each side of each vertical groove 21 is slanted as at 27.

Valve parts 11 and 12 have respective ports which may be brought into and out of registry by relative rotation of the parts. Thus, base 11 has a lateral port 28 which communicates between cavity 18 and the outside of the valve, and rotor 12 has an axial bore 29 opening through the bottom of part 16 and communicating with a lateral bore 31 opening on the outer side face of part 16 and positioned so as to be registrable with port 28 in one position of adjustment of the rotor 12. Base 11 also has an axial bore 30 communicating with bore 29.

The valve comprises a combination of elements having a dual function, whereby they restrain the bayonet joint from moving out of engaged position and also afford a means whereby the valve may be turned to closed position by feel alone, or by sound, without the need for visual attention. To this end, the flange 13 has a recess 32 of sector form cooperating with a leaf spring 33 embedded in a vertical channel in the outer wall of base 11, and extending above the top of the valve and adapted to arrest rotation of rotor 12 by contact with the side walls of sector recess 32. The spring, which is embedded in the valve in the process of molding, has an inwardly extending foot 34 which provides a secure anchorage. It will be noted that when detent 33 lies within recess 32, the general position of rotor 12 will be such that the ports 31 and 28 may be brought into or out of registry. The position where pins 19 may be moved along vertical grooves 21 is 90° removed from this position, so in order to provide for downward movement of the rotor, the top of the leaf spring 33 is bent as at 36 to permit downward movement of flange 13. The spring moves outwardly in this movement and, thereafter, will snap into recess 32 when the rotor is turned through about 90°, thus providing against unlocking of the bayonet joint and holding the rotor in proper position for valve operation.

As seen in Fig. 2, index marks are provided peripherally on the top of base 11 in a sector adjacent spring 33 and coextensive with the recess 32 in the rotor. The positions of the recess and the spring are such that passages 31 and 28 are out of communication when either side wall of the recess is in contact with spring 33. An index line 35 is provided on rotor 12 medially of recess 32 for cooperation with markings on the base 11 located on each side of detent 33, indicating the degree of opening of the valve ports. The central line of these markings is marked with an "O" to indicate fully open position of the valve, and the end lines are each marked with a "C" to indicate the two positions in which the valve is fully closed, that is, when either of the end walls of recess 32 is in contact with detent 33. In particular, the calibration may be arranged to read directly in drops per minute. However, the calibration may represent c. c. per minute, or degree of opening of the ports, or any other desired scheme.

In order to provide certainty of adjustment of the valve, and also to permit adjustment by sound or feel rather than inspection, a further spring member 37 may be employed. This spring has a lower end 38 having a foot 39, and embedded in base 11, near the top thereof, in the same manner as spring 33. Spring 37 also has an out-

wardly staggered, upper portion 40, which has an inwardly bent rib 41 with a sharp, inner edge 42 adapted to engage in vertical serrations 43 in flange 13. This spring will yield upon turning of the rotor and drop successively into the serrations on the flange while assisting spring 33 in limiting rotation of rotor 12. This provides perception of valve adjustment within recess 32 by sound or "feel." Furthermore, the spring 37 is so located that when it is adjacent index line 35, the pins 19 will be properly positioned for dropping into slots 21, and fumbling in the engagement of the bayonet connection is avoided.

The tubular needle 44 has a headed end 45 embedded in base 11 and is axially aligned with bore 30 therein. Base 11 has an integral, tubular nipple 46 providing an extension of bore 28 and adapted to receive the usual rubber tubing 47.

The valve is shown mounted on the rubber stopper 51 of a vacuum bottle 52, these parts also being conventional. The rubber stopper has an axial, blind bore 53 leaving a portion 54 of materially reduced depth of stopper through which is pierced the needle to communicate with the interior of the vacuum bottle. An auxiliary bore 56 may also be provided for cases wherein it is desired to introduce more than one fluid into the container. A slight recess 57 is provided on the top of the stopper, in alignment with each bore, to indicate the point where the needle is to be inserted. The stopper is composed of material which is self-sealing upon withdrawal of the needle.

In one manner of use, the valve is employed in metering the stream of whole blood being transferred from a donor to the vacuum bottle. In this operation, it is highly important that the rate of flow be under constant regulation, in varying degrees. Under the circumstances, and in view of the fact that the attendant is burdened with the necessity of constantly observing and coping with several factors during the short period of time consumed by the process, it will be apparent that a valve which may be accurately and rapidly regulated without visual attention will be highly beneficial. Furthermore, the valve provides features of safety which guarantee that it will not come apart due to any confusion or fumbling which the attendant may experience.

In drawing whole blood into a container under a condition of vacuum, it has been noted that in using a rotary valve, the blood tends to spread or seep out around the rotor. Since blood quickly coagulates, this has resulted in a sticking of the valve, which renders it useless. In the valve of this invention such drawback is effectively overcome by providing a baffle between the rotor and valve base. As shown, this baffle comprises an annular, upstanding rib 58 on the valve base 11, nested snugly in a corresponding annular channel 58' in the bottom of the rotor 12. With this arrangement, any blood which seeps between the bottom of the rotor and the bottom of well 18 must pass around the rib 58 before it can proceed radially outward to reach the wall of cavity 18. The extra path which the fluid must travel is measured by twice the height of rib 58. The period of time consumed in filling the container is sufficiently low that a rib of the height shown effectively prevents passage of fluid to cavity wall 18. Preferably, rib 58 will be located close to bore 29 so that considerable torque is available for breaking any bond at the rib caused by coagulation at this point.

Preferably, the base of the valve will have a peripheral flange 59 adapted to seat on the top of the stopper. This will assist in preserving conditions of sterility and will also tend to stabilize the assembly so that, among other things, the needle will not be likely to be accidentally bent or broken, or withdrawn.

The valve is especially useful in the separation of blood plasma from the whole blood. After the blood has been placed in the container 52, the blood corpuscles settle out and, thereafter, the supernatant plasma is drawn into another container. The flow of plasma must be regulated with close attention because if a single corpuscle were introduced into the plasma container, spoilage of the plasma would ensue. The valve shown is well adapted for the necessary close control and freedom from malfunctioning.

Among other things, the valve is simple and economical of manufacture. The main parts may be molded and may comprise hard rubber or a thermosetting synthetic

plastic. A variety of compositions may be suitable, but preferably they will be capable of withstanding a temperature of at least 212° F. without deleterious effects, so that the parts may be sterilized in an autoclave for re-use. However, this is not strictly necessary, for the valves can be manufactured so inexpensively as to warrant throwing them away after a single use.

Figs. 5 and 6 illustrate two of the possible variations in the manner of mounting the needle, wherein the needle is not permanently attached to the valve in the molding process.

In Fig. 5, the needle 53' has an integral end cup 61 with a frusto-conical cavity 62 adapted for friction fit on a corresponding frusto-conical boss 63 in an axial cavity 64 in the valve base 11'.

In Fig. 6, a metal insert 66, embedded in the valve base 11'' in the molding process, is interiorly threaded to receive the threaded end 67 of the needle 53''.

While certain preferred embodiments of the valve have been shown and described, the invention is not limited thereto, but only as shall appear from the spirit and scope of the appended claims.

What is claimed is:

1. A valve for use in controlling the passage of fluid therethrough comprising a first valve part having a cavity, a second valve part rotatable in said cavity, and baffle means between said valve parts comprising an annular rib on one of said parts concentric with and parallel to the axis of said cavity, the other of said parts having an annular channel receiving said rib, said first part having an axial bore communicating with the bottom of said cavity and a bore located transversely of said axis, and said second part having a bore with a portion axially located and in constant communication with the axial bore in said first part, and another portion adapted for registration with said transversely located bore upon rotation of said second part.

2. A valve for surgical use comprising a first valve part having a cavity, a second valve part rotatable in said cavity, and baffle means between said valve parts comprising an annular rib on one of said parts concentric with and parallel to the axis of said cavity, the other of said parts having an annular channel receiving said rib, said first part having an axial bore communicating with the bottom of said cavity and a bore located transversely of said axis, and said second part having a bore with a portion axially located and in constant communication with the axial bore in said first part, and another portion adapted for registration with said transversely located bore upon rotation of said second part, said parts having contacting surfaces in a plane perpendicular to the axis of turning of said second part, one of said contacting surfaces having an annular channel concentric with said axis, and a resilient sealing ring in the last-mentioned annular channel, said ring in the unstressed state having a thickness slightly greater than the depth of said last-mentioned channel.

3. A valve for surgical use comprising a first valve part having a cavity, a second valve part rotatable in said cavity, and baffle means between said valve parts comprising an annular rib on one of said parts concentric with and parallel to the axis of said cavity, the other of said parts having an annular channel receiving said rib, said first part having an axial bore communicating with the bottom of said cavity and a bore located transversely of said axis, and said second part having a bore with a portion axially located and in constant communication with the axial bore in said first part, and another portion adapted for registration with said transversely located bore upon rotation of said second part, means holding the parts connected together while permitting rotation of said second part relatively of said first part, said second part having a flange with a peripheral notch, and a spring element carried by said first part and adapted to engage in said notch to limit rotation of said second part in a range of selected positions wherein the bores in the respective parts may be brought into registration.

4. A valve for surgical use comprising a first valve part having a cavity, a second valve part rotatable in said cavity, and baffle means between said valve parts comprising an annular rib on one of said parts concentric with and parallel to the axis of said cavity, the other of said parts having an annular channel receiving said rib, said first part having an axial bore communicating with the

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bottom of said cavity and a bore located transversely of said axis, and said second part having a bore with a portion axially located and in constant communication with the axial bore in said first part, and another portion adapted for registration with said transversely located bore upon rotation of said second part, means holding the parts connected together while permitting rotation of said second part relatively of said first part, said second part having a flange with a peripheral notch, and a spring element carried by said first part and adapted to engage in said notch to limit rotation of said second part in a range of selected positions wherein the bores in the respective parts may be brought into registration, said flange having a serrated periphery, and a yieldable spring detent carried by said first part and adapted to engage, successively, in the serrations of said periphery to assist said spring element in limiting rotation of said second part.

5. A valve for surgical use comprising a first valve part having a cavity, a second valve part rotatable in said cavity, and baffle means between said valve parts comprising an annular rib on one of said parts concentric with and parallel to the axis of said cavity, the other of said parts having an annular channel receiving said rib, said first part having an axial bore communicating with the bottom of said cavity and a bore located transversely of said axis, and said second part having a bore with a portion axially located and in constant communication with the axial bore in said first part, and another portion adapted for registration with said transversely located bore upon rotation of said second part, means holding the parts connected together while permitting rotation of said second part relatively of said first part, said second part having a flange with a peripheral notch, and a spring element carried by said first part and adapted to engage in said notch to limit rotation of said second part in a range of selected positions wherein the bores in the respective parts may be brought into registration, said flange having a serrated periphery, and a yieldable spring detent carried by said first part and adapted to engage, successively, in the serrations of said periphery to assist said spring element in limiting rotation of said second part, said detent being located 90° from said spring element angularly of said valve.

6. A valve for surgical use comprising a first valve part having a cavity, a second valve part rotatable in said cavity, and baffle means between said valve parts comprising an annular rib on one of said parts concentric with and parallel to the axis of said cavity, the other of said parts having an annular channel receiving said rib, said first part having an axial bore communicating with the bottom of said cavity and a bore located transversely of said axis, and said second part having a bore with a portion axially located and in constant communication with the axial bore in said first part, and another portion adapted for registration with said transversely located bore upon rotation of said second part, means holding the parts connected together while permitting rotation of said second part relatively of said first part, said second part having a flange with a peripheral notch, and a spring element carried by said first part and adapted to engage in said notch to limit rotation of said second part in a range of selected positions wherein the bores in the respective parts may be brought into registration, and index lines on said first part arranged on each side of said spring element, said index lines being located so as to be visible at any time through said peripheral notch.

7. A valve for surgical use comprising a first valve part having a cavity, a second valve part rotatable in said cavity, and baffle means between said valve parts comprising

ing an annular rib on one of said parts concentric with and parallel to the axis of said cavity, the other of said parts having an annular channel receiving said rib, said first part having an axial bore and communicating with the bottom of said cavity, a bore located transversely of said axis, and said second part having a bore with a portion axially located and in constant communication with the axial bore in said first part, and another portion adapted for registration with said transversely located bore upon rotation of said second part, and a hollow, surgical needle carried by said first part and in communication with the axial bore thereof, the outer end of said needle extending outwardly of said first part.

8. A valve for use in controlling the passage of fluid therethrough, comprising a base member having a cavity, a rotor member rotatable in said cavity relative to said base member, baffle means between said base and rotor members comprising an annular rib on one of said members concentric with and parallel to the axis of said cavity, the other of said members having an annular channel receiving said rib, said base member having an axial bore communicating with the inner end of said cavity and a bore located transversely of said axis, and said rotor member having a bore with a portion axially located and in constant communication with the axial bore in said base member, and another portion adapted for registration with said transversely located bore upon rotation of said rotor member relatively to said base member, said members having contacting surfaces in a plane perpendicular to the axis of rotation of said rotor member, one of said contacting surfaces having an annular channel concentric with said axis, a resilient sealing ring in the last mentioned annular channel, said ring in the unstressed state having a thickness slightly greater than the depth of said last mentioned channel, and a hollow needle carried by said base member and in communication with the axial bore thereof, the outer end of said needle extending outwardly of said base member.

9. A valve for use in controlling the passage of fluid therethrough, comprising a base member having a cavity, a rotor member rotatable in said cavity relative to said base member, complementary fluid sealing means carried by said members adjacent the inner end of said rotor, said base member having an axial bore communicating with the inner end of said cavity and a bore located transversely of said axis, and said rotor member having a bore with a portion axially located and in constant communication with the axial bore in said base member, and another portion adapted for registration with said transversely located bore upon rotation of said rotor members relatively to said base member, a bayonet connection between said members including an annular groove in said base member laterally of said cavity and at least one lateral projection on said rotor member receivable in and rotatable in said groove, and a secondary, flexible and compressible fluid sealing means between said base member and rotor member and located intermediate said bayonet connection and said first mentioned sealing means.

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