Oct. 4, 1966 C. W. JINKENS ET AL 3,276,472

MEDICAL VALVE

Filed Dec. 3, 1963

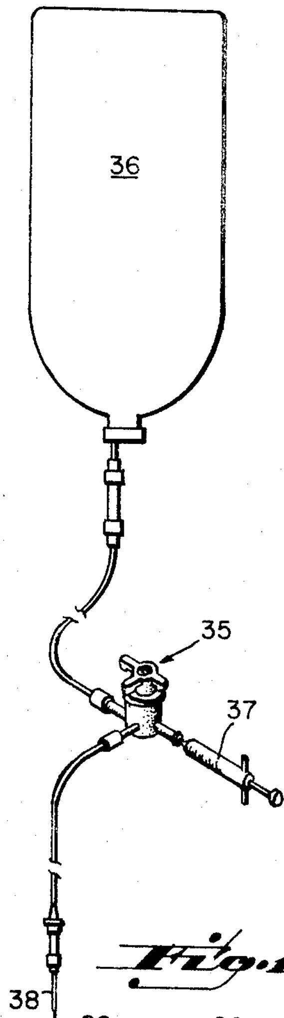

Fig. 1

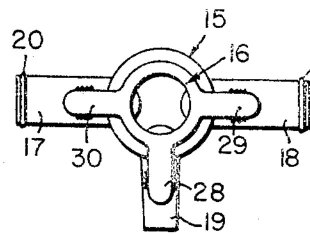

Fig. 4

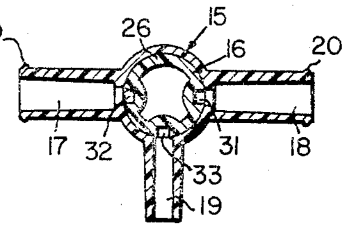

Fig. 5

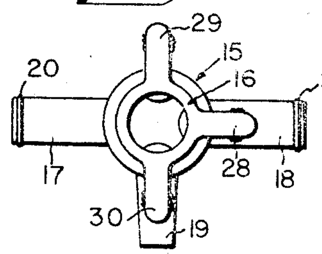

Fig. 6

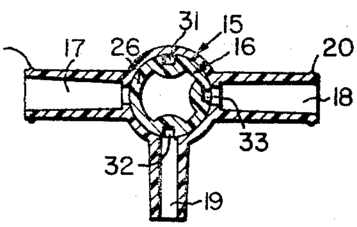

Fig. 7

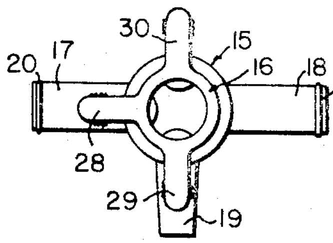

Fig. 8

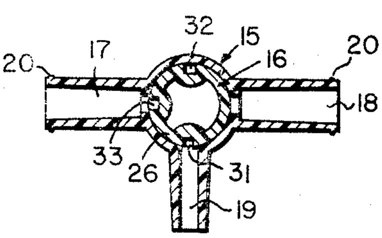

Fig. 9

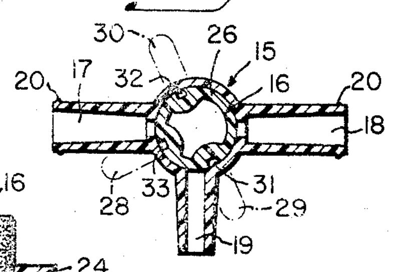

Fig. 10

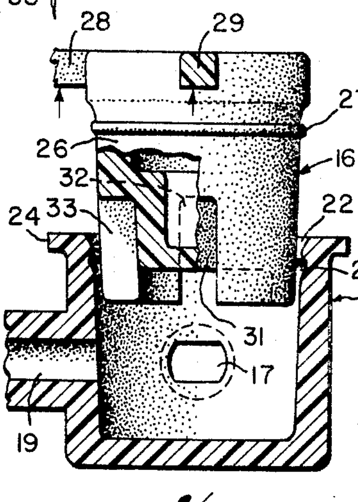

Fig. 2

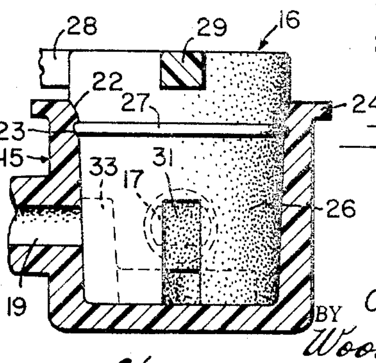

Fig. 3

INVENTORS.
Charles W. Jinkens
Charles C. Waldbillig
BY
Wood, Herron & Evans
ATTORNEYS

United States Patent Office

3,276,472

Patented Oct. 4, 1966

3,276,472

MEDICAL VALVE

Charles W. Jinkens and Charles C. Waldbillig, Columbus, Ohio, assignors to Medex, Inc., Columbus, Ohio, a corporation of Ohio

Filed Dec. 3, 1963, Ser. No. 327,685
2 Claims. (Cl. 137—556)

This invention relates to valves, and more particularly to a valve that is especially adapted for medical and surgical uses.

During the last fifty years medical technology relating to the intravenous injection of drugs and solutions has undergone rapid and significant advances. Where before a patient had to be fed orally, today he can be fed intravenously with a glucose solution. Not long ago the most common anesthetic was ethyl ether, administered through the respiratory tract. Today a physician may select an anesthetic from a large number of compounds which are administered intravenously by mixing them, in very small amounts, with a glucose solution.

Unfortunately, marked developments have not been made in the apparatus through which these solutions and drugs are administered. One deficiency in the intravenous injection apparatus has been the valve that should quantitatively and selectively control the simultaneous flow of two intravenous liquids.

Although it is difficult to particularly point out the deficiencies of the prior valves it can be generally said that in some valves the selective and quantitative flow control functions have been sacrificed for simplicity; in others for ease of manufacturing; in some for operational safety; while others have sacrificed the latter features for the former. Heretofore no valve has possessed all of these features.

It has been one of the objectives of the invention to provide the medical and surgical profession with a valve, that through a novel disposition of flow channels and ducts can selectively and quantitatively control the simultaneous flow of two intravenous liquids.

Another object has been to provide a valve which through the novel position of its handle arms relative to its ducts and flow channels, is so simple and infallible to operate that to select the intravenous liquid and/or liquids to be administered the handle arms are turned to align them with the ducts that receive the liquids and to the duct that delivers them.

Still another of our objectives has been to provide a valve comprised of a casing and a plug, respectively molded from a polycarbonate or polypropylene and a high density polyethylene. These materials are ideally suited for this application in at least two respects. Their surface characteristics provide the requisite degree of friction to prevent the unintentional turning of the plug when it is engaged with the casing. Further, the materials can be autoclaved without distortion or other deleterious effects.

A further objective has been to provide a medical and surgical valve comprising a plug and a casing which are molded but do not require any subsequent machining. This objective embraces the plug configuration which includes the location of flow channels, handle arms and sealing ring. The preferred configuration permits the plug to be molded in that type of cavity from which it may be ejected axially thereby eliminating any flash which must be removed by machining. Further, flow channels are provided while preserving a uniform wall thickness which minimizes any tendency of the plug to distort upon cooling after molding.

Thus the plug configuration permits its formation with a minimum expense while permitting the holding of close

tolrances through which the desired cooperation of the plug and casing is attained without leakage.

Another objectve of the invention has been to provide a valve adapted to permit the supply of either or both of two fluids to an outlet duct and which is adapted to be shifted to an aspirating position wherein the outlet is closed and the two inlet ducts are in communication with each other. The aspirating position permits the manipulation of a syringe connected to one outlet port to draw in, or aspirate fluid from the other inlet duct and thereafter, upon shifting of the valve, to drive the fluid from the syringe to the outlet duct. The valve can be used for aspirating in at least two situations. With certain types of anesthetic, it is desirable to mix the anesthetic with the intravenous solution before it is applied to the patient. A small amount of the anesthetic is put into the syringe and then with the valve shifted to close the outlet duct to provide communication between the two inlet ducts. The syringe plunger is withdrawn to draw a glucose solution into the syringe barrel to mix it with the anesthetic. Thereafter, the valve is shifted to connect the syringe duct to the outlet duct so that the mixture of anesthetic and glucose solution can be injected into the patient. The valve is manipulated in an identical manner to pump blood into a patient by first drawing the blood into a syringe barrel then, after shifting the valve to inject the blood into the patient under pressure.

These and other objectives of our invention will become more readily apparent from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is an elevational view showing the invention used to control the simultaneous intravenous injection of two solutions,

FIG. 2 is a cross sectional view partly in section of the valve with the plug partially removed,

FIG. 3 is a cross sectional view of the valve with the plug engaged in the casing,

FIG. 4 is a top plan view of the valve showing all ducts in communication,

FIG. 5 is a cross sectional view of the valve of FIG. 4,

FIG. 6 is a top plan view of the valve showing one inlet duct and the outlet duct open,

FIG. 7 is a cross sectional view of the valve of FIG. 6,

FIG. 8 is a top plan view of the valve showing another inlet duct and the outlet duct open,

FIG. 9 is a cross sectional view of the valve of FIG. 8,

FIG. 9 is a cross sectional view of the valve showing the inlet and outlet ducts closed.

The preferred embodiment of the invention comprises a molded polycarbonate casing **15**, and a molded plug **16** made from a high density polyethylene. It has been found that molding the casing **15** from a polycarbonate provides a surface with a relatively high co-efficient of friction that hinders the rotation of the plug **16** when it is engaged with the casing, the mechanics of which will be described later. Although the plug **16** can still be rotated, the frictional surface of the casing minimizes the possibility of the plug being rotated unintentionally. The plug **16** is molded in a mold from which it is axially withdrawn so that the need for subsequent machining and turning to remove the flash is eliminated. Polypropylene exhibits characteristics similar to those of polycarbonate. While it is perhaps not quite so desirable a material, it is considerably less expensive.

The casing **15** is hollow, cylindrical in cross section and closed at its bottom end. Three ducts, two inlet ducts **17** and **18**, and one outlet duct **19**, spaced 90° apart, lead from the interior to the exterior of the casing **15**. These ducts are formed in part by elongated radially projecting spigots. The inlet ducts 17 and 18 are constructed so that at their junction with the interior of the casing 15 their axial dimension is smaller than their circumferential dimension to form a generally oval shaped orifice.

This orifice must have a predetermined minimum cross sectional area. By making the circumferential dimension long, communication of the orifice with the plug flow channels can be made without requiring precise angular positioning of the plug. The axial dimension is short to maintain the orifice area small, thereby minimizing the pressure on the plug walls which could cause leakage. At the exterior ends of the inlet ducts 17 and 18 are Luer locks 20 (which are fittings commonly used with hypodermic syringes) that receive and lock a standard size tubular fitting on a syringe or tube carrying the intravenous solution.

The interior of the casing 15 is flared outwardly at its upper end 22 and slightly tapered toward its lower end. Adjacent to the upper end 22 is an annular groove 23. Circumferentially formed around the top of the casing 15 is a flange 24.

The molded plug 16 has a barrel 26 that is slightly tapered toward its bottom. Near the top of the barrel 26 is an annular rib 27 which is sealed in the annular groove 23. At the top of the plug 16 and projecting radially outwardly a distance at least equal to the radius of the plug are three handle arms 28, 29 and 30 spaced 90° apart. The arms 28, 29 and 30 not only provide a means for turning the plug but additionally provide a means for indicating the flow of different intravenous solutions, and still further, provide a means engageable by mold knock out pins for axially removing the plug from the mold. At the end of the barrel 26 are three rectangular flow channels 31, 32 and 33 spaced 90° apart in the same angular position as the arms 28, 29 and 30. These channels cooperate with the ducts 17, 18 and 19 to control the flow and selection of the intravenous solutions. There is a circular recess in the bottom of the plug 16 which provides a communication among the several channels 31, 32 and 33 thereby enabling fluids to flow from the inlet ducts 17 and 18 to the outlet duct 19 when the channels 31, 32 and 33 are aligned with the ducts. The recess also provides a plenum chamber for the ducts, facilitating the 90° turn which the fluid must take to pass from an inlet duct to an outlet duct. The top of the plug 16 is recessed or cup shaped. The plug walls which form the flow channels 31–33 are depressed into the upper recess. Constructing the plug walls in this manner and recessing the top and bottom of the plug provides a uniform wall thickness throughout the plug 16 thereby eliminating distortion of the plug in the molding and cooling process.

The molded valve components, the casing 15 and the plug 16, are assembled by pushing the plug 16 into the casing 15. The annular rib 27 "snaps" into the annular groove 23 thereby providing an excellent seal that prevents leakage and provides an efficient locking device preventing the accidental withdrawal of the plug 16 from the casing 15. The rib 27 has a sufficient radial dimension to provide the liquid tight seal but the dimension is not so great as to prevent axial removal of the plug from the mold cavity or to prevent the easy assembly of the plug with the casing.

In operation, the valve 35 is employed in an intravenous injection system as shown in FIG. 1. The bottle 36 may contain a glucose solution and the syringe 37 an anesthetic. A needle 38 is inserted into the patient's arm and delivers the solutions.

The valve 35 is simple to operate and is practically infallible. For instance, as shown in FIGS. 4–5, the inlet ducts 17 and 18 and the outlet duct 19 are open and the solutions contained in the bottle 36 and the syringe 37 may pass simultaneously through the needle 38 and into the patient's body. This occurs because the flow channels 31, 32 and 33 are aligned with the ducts 17–19.

If only the anesthetic is to be injected the handle arms 28, 29 and 30 are turned to the position shown in FIG. 6. As can be seen in FIG. 7, the glucose solution can not enter the valve because the flow channel 31 does not cooperate with the inlet duct 17. Instead the barrel 26 of the plug 16 seals off the glucose solution and prevents it from flowing to the outlet duct 19. However, the anesthetic is free to flow through the valve since the flow channel 33 cooperates with the inlet duct 18 and the outlet duct 19 cooperates with the flow channel 32. Similarly, if only the glucose solution is to be administered, the handle arms 28, 29 and 30 would be turned to the position shown in FIG. 8. As shown in FIG. 9, with the handle arms 28, 29 and 30 turned in this position the flow channels 31 and 33 woud permit the glucose solution to flow through the inlet duct 17 and the outlet duct 19. The other inlet duct 18 would be closed by the barrel 26 and therefore the anesthetic could not flow to the outlet duct 19. To prevent the flow of either solution the handle arms 28, 29 and 30 are turned slightly, approximately one-eighth of a turn from any open position such as from the fully open position as shown in FIG. 4, to a position such as shown in broken lines in FIG. 10 where the flow channels 31, 32 and 33 do not cooperate with any of the ducts 17, 18 and 19.

The valve can also be used for aspirating and for that purpose utilizes a position, not specifically shown in the drawings. The aspirating position would be the position of FIGS. 4 and 5 with the plug turned through an angle of 180° to block outlet duct 19 and to provide communication between ducts 17 and 18. The aspirating position of the plug is used when it is desired to mix the glucose solution with the anesthetic to be injected into the patient prior to the ejecting of the anesthetic from the syringe. Alternatively, it is used when it is desired to pump blood from a supply bottle 36 into the patient the syringe 37 being used as a pump. The operations are similar to each other. First, the valve plug is shifted to close outlet duct 19 and to interconnect ducts 17 and 18. The syringe plunger 38 is then withdrawn to draw fluid through the inlet duct 17 to the duct 18 attached to a syringe. The valve is then shifted to the positions of FIGS. 6 and 7 to connect the syringe directly to the hypodermic needle 38. The plunger of the syringe is then operated to drive the fluid from the syringe through duct 18 and out duct 19 to the hypodermic needle.

It can be seen that the valve is simple to operate since the handle arms indicate what solution or solutions are flowing through which duct. This prevents any guessing as to what will happen when the plug is turned and minimizes the possibility of a human error.

Although our invention has been described in its preferred embodiment with a certain degree of particularity, it is understood that our present disclosure has been made by way of example and that changes in the construction, combination and arrangements of parts may be resorted to without departing from the spirit of our invention.

Having described our invention we claim:

1. A valve comprising,

a cup shaped casing of circular cross section having a plurality of ducts extending from the interior of said casing to the exterior of said casing, said ducts being formed in part by elongated spigots projecting radially from said casing,

said casing having an internal annular groove above said ducts,

a circular plug having a generally cylindrical surface,

an external annular rib on the upper portion of said plug in sealing and locking engagement with said annular groove,

said plug having a recess in its lower end and axially extending flow channels in the cylindrical surface of said plug communicating with said recess while extending above said recess but terminating below said rib, said channels being selectively alignable with said ducts, and

elongated handle arms on said plug extending outwardly therefrom, said arms being in the same angular positions as said channels, said handle arms being alignable with said spigots.

2. A valve comprising,

a cup shaped casing of circular cross section having three ducts extending from the interior of said casing to the exterior of said casing and being angularly spaced apart by 90°, said ducts being formed in part by elongated spigots projecting radially from said casing, the bottom of said casing extending well below said spigots,

said casing having an internal annular groove above said ducts,

a circular plug having a generally cylindrical surface,

an annular rib on the upper portion of said plug in sealing and locking engagement with said annular groove,

said plug having a recess in its lower end and three axially extending flow channels in the cylindrical surface of said plug communicating with said recess while extending above said recess but terminating below said rib, and angularly spaced apart by 90°,

said channels being selectively alignable with said ducts, and

three elongated handle arms on said plug extending outwardly therefrom, said arms being in the same angular positions as said channels, said handle arms being alignable with said spigots.

References Cited by the Examiner

UNITED STATES PATENTS

1,240,023	9/1917	Brunk	137—556
2,735,699	2/1956	Chadbourne	285—423 X
2,854,027	9/1958	Kaiser et al.	251—368 X
2,889,089	6/1959	Herrick et al.	285—423 X
3,012,752	12/1961	Buck	251—309
3,048,192	8/1962	Murphy	251—368 X
3,057,350	10/1962	Cowley	137—625.41 X

FOREIGN PATENTS

543,733	3/1942	Great Britain.

M. CARY NELSON, *Primary Examiner.*

H. KLINKSIEK, *Assistant Examiner.*