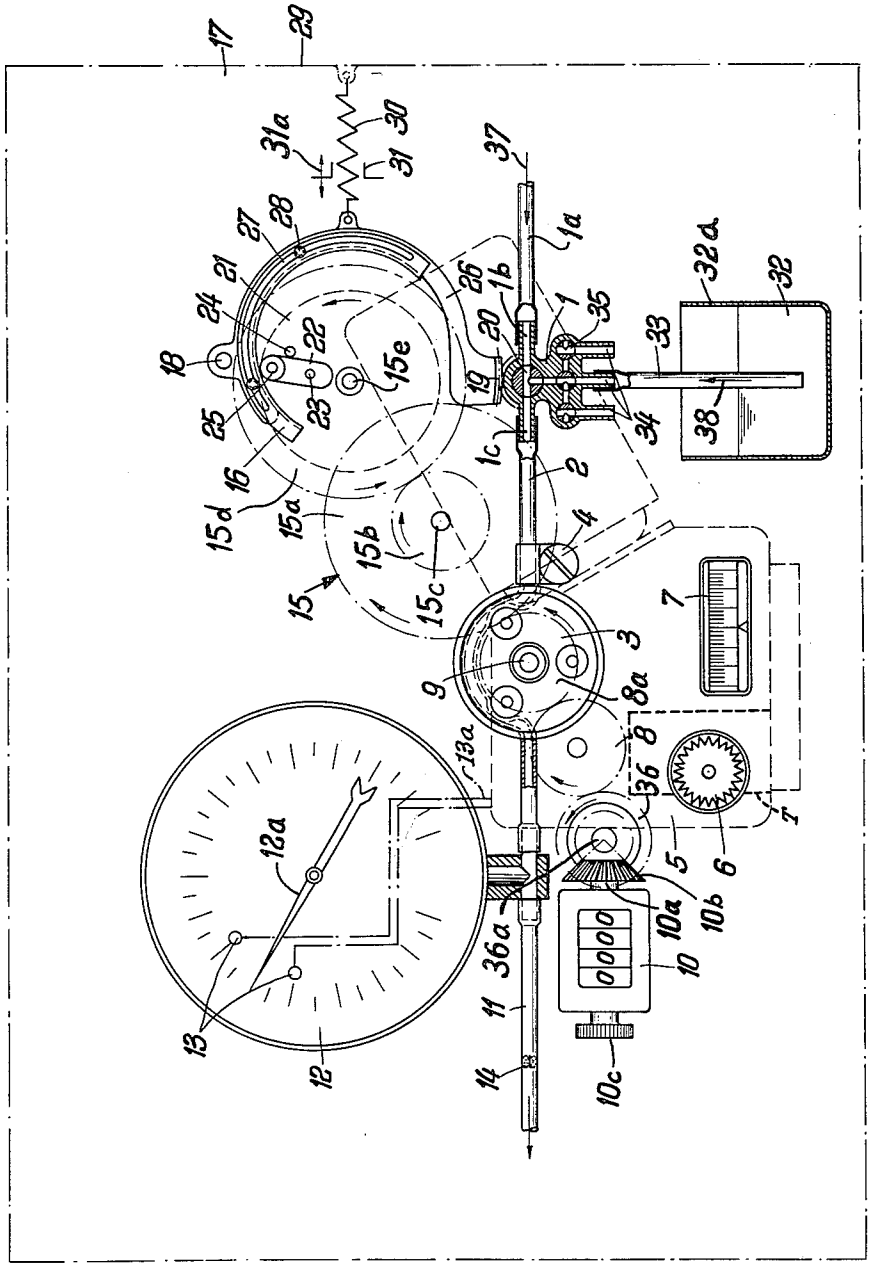
May 28, 1963 W. MOELLER 3,091,239

APPARATUS FOR INTRAVASAL INJECTION OF GASEOUS AND LIQUID MEDIA

Filed Aug. 25, 1959



Inventor:
WILHELM MÖLLER
BY
Michael S. Striker
ATTORNEY

United States Patent Office 3,091,239 Patented May 28, 1963

3,091,239

APPARATUS FOR INTRAVASAL INJECTION OF GASEOUS AND LIQUID MEDIA

Wilhelm Moeller, Wilhelmshöher Allee 5, Kassel, Germany

Filed Aug. 25, 1959, Ser. No. 835,894
Claims priority, application Germany Aug. 25, 1958
9 Claims. (Cl. 128—214)

The present invention relates to an apparatus for intravasal introduction of gasiform, and for infusion of liquid, medicines or other fluids into human and animal bodies. More particularly, the invention relates to an apparatus, known as insufflator, which is utilized by the medical profession in treatment of chronic heart ailments and chronic ailments of the circulatory system due to lack of oxygen or other substances, in the treatment of brain and other organs in a human or animal body, in the treatment of cancerous tissue, in the treatment of lungs of asthmatic patients, and for many other purposes.

It is already known to inject a liquid or gasiform medicine or another treating medium which is supplied by a pressurized container directly into the blood vessel without utilizing a dosing or measuring pump in the conduit means which connects the cannula with the source of pressurized fluid. The quantity of injected fluid medium then depends upon the back pressure met by the medium during entry into the blood vessel, i.e., upon the blood pressure, and also upon the actual pressure at which the medium is released from its container. The disadvantage of such insufflators is in that the exact quantities of medium introduced into the system of a patient are not independent from the pressures prevailing in the punctured vessel. In addition, the presently utilized apparatus of such character can introduce only comparatively large quantities of a fluid medium and are capable of operating without interruption for relatively sort periods of time. Moreover, the presently known insufflators require constant attention in order to conform the pressure of injected fluid medium to the momentary back pressure prevailing in the circulatory system, and the cylinder from which the fluid is fed must be refilled at frequent time intervals. Even if a pressure reducing device is installed between the cylinder and the cannula, and even if a pressure regulator is utilized in the cylinder, an accumulation of excessive fluid quantities just before the entry into a vessel while the pressure of fluid overcomes the momentarily prevailing back pressure in the vessel cannot be aovided. This brings about the danger that excessive quantities of a fluid are injected into the veins and, in addition, renders impossible proper control of the quantities delivered to a patient's system. Still further, no presently known apparatus for such purposes is capable of simultaneously controlling the delivery of gasiform and/or liquid media to two or more patients, which renders it necessary to employ a large number of skilled attendants.

An object of the present invention is to provide a mechanically driven and fully or nearly fully automatic insufflator of the type which requires attention by a single operator and which is capable of simultaneously delivering gasiform and/or liquid media to two or more patients.

Another object of the invention is to provide an insufflator which is equally suitable for intraarterial (high pressure) as well as for intravenous (low pressure) injection or infusion of a fluid medium.

A further object of the invention is to provide an apparatus for intravasal injection of fluids which is capable of delivering predetermined quantities of a fluid regardless of the back pressures prevailing in the blood vessels.

An additional object of the invention is to provide an

apparatus of the above outlined characteristics which is capable of simultaneously injecting two or more fluids into the circulatory system of a patient.

A concomitant object of the instant invention is to provide an insufflator which is capable of automatically controlling or measuring the injection of two or more gasiform and/or liquid media and which may be readily adapted for delivery of one, two or more fluids.

Still another object of the present invention is to provide an insufflator which is capable of delivering fluids into a blood vessel for very long and practically unlimited periods of time without requiring interruption of the treatment, and which is so constructed that an accumulation or excessive dosage of fluid at the start of insufflation is positively prevented.

A further object of the invention is to provide an insufflator which is so constructed that the back flow of blood from the punctured vessel into which the cannula is inserted is prevented even if the pressures generated by the insufflator are lower than those prevailing in the vessel.

With the above objects in view, the invention resides in the provision of an insufflator which comprises a pump driven by a suitable motor over an infinitely variable speed transmission, the pump being connected to one or more sources of fluid media and delivering the fluid at a predetermined pressure to the cannula inserted into the blood vessel or another part of a patient's body. Of course, the pump is capable of simultaneously delivering controlled quantities of fluid at predetermined pressures to more than a single cannula, if desired. The supply conduit leading to the pump preferably contains a pressure reducing multi-way valve whose intake nipple or nipples may be connected to one, two or more sources of gasiform and/or liquid treating media, and an automatic control system is preferably provided to actuate at least one plug of the multi-way valve in such a way that a single fluid is injected either continuously or at exactly predetermined intervals of time, or that the injection of one fluid alternates with the injection of one or more additional fluids. The automatic control system is driven by the pump motor and comprises a cam and follower assembly which is adjustable so as to vary the length of intervals between successive injections and also the duration of actual injections, if necessary. The multi-way valve is utilized whenever it is desired to insufflate two or more fluids into a patient's body.

Certain additional features of the invention reside in the provision of means for automatically adjusting the speed of the pump motor when the pressure of injected fluid exceeds or drops below a predetermined range; in the provision of means for preventing the pump from drawing into its gears the discharge end of the supply conduit means; in the provision of means, such as a counting mechanism, which records and continuously indicates the exact quantities of injected fluid; and in the provision of means, e.g., a check valve, which prevents the flow of blood or other liquid into the insufflator when the pressures generated by the pump are lower than the pressures prevailing in the blood vessel into which the cannula is inserted.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of a specific embodiment when read in connection with the accompanying drawing the single FIGURE of which is a schematic representation of the insufflator with certain parts shown in vertical section.

Referring now in greater detail to the drawing, there is shown an insufflator which comprises an inlet tube 1*a*

connected to a non-represented fluid source such as a high-pressure cylinder containing, for example, oxygen, an antiseptic substance, a stimulant, or any other fluid medium which is to be injected in carefully controlled quantities and at carefully controlled pressures into a patient's body. Before entering the tube or conduit 1*a*, the medium to be insufflated is caused to pass through customary wet and dry filters, not shown. The preferably flexible tube 1*a* is connected to the intake nipple 1*b* of a pressure reducing multi-way valve 1 whose discharge nipple 1*c* is connected with the intake end of a supply tube or conduit 2 leading the medium passing therethrough to the suction side of a fluid quantity and pressure regulating pump 3. A tube clamp or clip 4 is provided to prevent the discharge end of supply conduit 2 from being drawn into the pumping device 3. The latter is driven by a motor 5 through an infinitely variable transmission indicated at T, the angular speed of motor 5 being adjustable by a knob 6. The infinitely variable transmission T mounted in the housing of the motor 5 may be of any known design, for example, a transmission utilizing friction discs or conical motion transmitting pulleys. The knob 6 controls the position of a spindle which, in a manner well known in the art, controls the spacing between the motion transmitting parts. A scale 7 furnishes accurate readings as to the speed of pump 3. The shaft 9 of the pumping device drives the shaft 10*a* of a counting or recording mechanism 10 through a coaxial gear 8*a*, an idler gear 8, a bevel gear 36 whose shaft 36*a* is rotatably mounted in the side wall 17 of the insufflator housing, and a meshing bevel gear 10*b* mounted on the shaft 10*a*. The adjusting knob 10*c* serves as a means for returning the counting mechanism 10 into zero position after each use of the insufflator.

The pressure side of pump 3 delivers measured quantities of a fluid medium, e.g., oxygen, into a pressure line 11 in which is installed a pressure gauge 12 whose finger or indicator 12*a* is free to perform angular movements between a pair of spaced stops or arresting pins 13 mounted at the opposing sides of member 12*a* and both installed in the electric circuit of the motor 5 as indicated in chain lines at 13*a*. The distance between and the positioning of stop pins or terminals 13 with respect to the scale of pressure gauge 12 depends upon the desired range of pressures at which the medium should be injected into the body of a patient. Thus, as soon as the pressure of a fluid medium in line 11 exceeds or drops below a permissible maximum or minimum value, the finger 12*a* comes into contact with the one or the other pin 13 and, through the non-represented electric connection, causes the transmission which is driven by motor 5 either to reduce or to increase the speed at which the shaft 9 of pump 3 is driven so as to maintain the pressure in line 11 within a given range.

The quantities of fluid medium delivered by pump 3 depend solely upon the setting of the transmission in the housing of motor 5, i.e., only upon the angular speed of the pump shaft 9. The fluid passing through the line 1*a* is maintained at constant pressure which preferably only slightly exceeds the atmospheric pressure. The quantity of fluid delivered from the multi-way valve 1 to pump 3 may be varied by utilizing conduits 2 of different diameters. The disengagement of supply conduit 2 whose discharge end with the clip 4 thereon normally extends into the housing of pump motor 5 is facilitated by the provision of a non-represented bayonet lock or like readily separable connecting means for the cover of the pump and motor housing.

Upon each revolution of the pump shaft 9, an exactly determined quantity of fluid is caused to enter into the pressure line 11. The quantity of fluid delivered by pump 3 in a unit of time equals the capacity of the pump multiplied by the number of revolutions performed by shaft 9 in the same unit of time. Since the angular speed of shaft 9 is infinitely variable by the knob 6, the quantity of fluid medium injected into a patient's system in a unit of time may be determined in advance and may remain unchanged for hours and even days, if desired and necessary.

The contact pressure gauge or manometer 12 may be connected with a visible- and/or audible-alarm producing device, not shown, to immediately warn an attendant that the pressure of fluid in line 11 is either below or above the permissible magnitude. In addition to the aforementioned electrical connection 13*a* between the stop pins or terminals 13 and the motor 5, there may be provided a hand-actuated switch for arresting the motor as soon as the pressure in line 11 exceeds or drops below the predetermined permissible magnitude. The range of permissible pressures in line 11 normally increases with the increase in the pressure of fluid. When the operation begins, the motor 5 is preferably started in a first step and the delivery of fluid to the pump 3 is started in a subsequent step.

Since the delivery of fluid into the pressure line 11 depends solely upon the angular speed of pump shaft 9, the injection into a blood vessel is fully independent from the pressures prevailing in the vessel. By varying the angular speed of pump shaft 9, the quantity of injected fluid medium per unit of time may be readily adjusted to correspond to the circulatory condition of an individual patient or to the condition of another system or organ which is treated by the fluid infused or injected by the insufflator.

The discharge end of pressure line 11 is connected to a non-represented cannula, and the line 11 further contains a check or back pressure valve 14 which prevents the flow of blood from the puncture vessel into the line 11 when the pressure of medium delivered by pump 3 is lower than the pressure prevailing at the left-hand side of valve 14. This valve is preferably installed in a transparent housing made of a plastic or the like.

The automatic control connection between the shaft 9 of pump 3 and the pressure reducing multi-way valve 1 comprises a gear transmission 15 and a control cam 16 whose momentary position is determined by the transmission 15 and a spring 30. The cam 16 is adjustably mounted on a carrier 26 which latter is swingable about a pivot axle 18 mounted on the insufflator wall 17. At its lower end distant from the pivot axle 18, the carrier or support 26 is formed with a toothed segment 19 which meshes with a similarly toothed member or gear wheel connected to the plug 20 of multi-way valve 1, the latter determining the quantity of a fluid medium passing from line 1*a* through the nipples 1*b*, 1*c* and into the supply line 2 leading to the pumping device 3. The toothed member mounted on the plug 20 and the segment 19 may be replaced by a system of levers (not shown) or by any other means capable of transmitting swinging movements of carrier member 26 to the plug 20.

The intermediate gear transmission 15 comprises a large gear 15*a* which is coaxially mounted with a smaller gear 15*b* on the shaft 15*c*, the latter being fixed to the apparatus wall 17. Gear 15*a* meshes with the gear 8*a* driven by the pump shaft 9. The smaller gear 15*b* meshes with a further gear 15*d* which is coaxially mounted with a follower disc 21 on a further shaft or pivot axle 15*e* carried by the wall 17. The transmission 15 controls the duration of, and the length of intervals between, successive injections of a fluid medium passing from line 1*a* into the supply line 2 and thence to the cannula at the discharge end of pressure line 11.

The follower disc 21 carries an eccentrically mounted lever 22 which is swingably fixed thereto by a pin or pivot axle 23. The lever 22 carries a roller 25 and its swinging movements in one direction (clockwise in the drawing) are limited by a stop or arresting pin 24 which is fixed to the disc 21. The follower roller 25 travels along the arcuate or concave inner surface of the control cam 16 when the disc 21 is rotated in anticlockwise direction and

the lever 22 abuts against the arresting means 24. The axis of roller 25 is parallel with the axis about which the carrier 26 rotates. The cam 16 is adjustably fixed to its carrier or support 26 by means of screws 28 which extend through an arcuate slot 27 formed in the member 16. Thus, by releasing the screws 28, cam 16 may be angularly adjusted with respect to the carrier 26 in order to vary the extent to which the latter may be rocked by the follower roller 25. As soon as the roller 25 is moved out of contact with the inner surface of cam 16, the resilient member here shown as a helical spring 30 immediately rocks the carrier 26 and cam 16 in anticlockwise direction about the pivot axle 18. The spring 30 is fixed to the carrier 26 and to the side wall 29 of the insufflator. The extent of anticlockwise rocking movements performed by the carrier 26 under the influence of resilient member 30 is adjustable by a schematically represented stop or arresting device 31 which is fixed to the wall 17 and is movable therealong in the directions indicated by the double arrow 31*a*. When the carrier 26 is rocked by spring 30, its segment 19 displaces the plug 20 into a position to permit entry of controlled quantities of fluid from the line 1*a* through the valve 1 and into the supply line 2.

Controlled quantities of a second fluid medium 32, e.g., a liquid, may be introduced from a second fluid source, such as a tank 32*a*, through a conduit 33 which is connected to one of the intake nipples 34 forming part of the multi-way valve 1. The plugs 35 controlling the flow of various media through the intake nipples 34 may be adjusted by hand or by a non-represented automatic control system. The tank 32*a* may contain a liquid medicine, a stimulant or any other fluid which should be insufflated in controlled quantities and at controlled pressures into a patient's system. The pump 3 generates a suctional force of desired magnitude to draw the fluid medium 32 from the container or receptacle 32*a* through the conduit 33 and valve 1 into the supply line 2.

When the insufflator is utilized for injection or infusion of a single fluid medium, the lever 22 is moved into a position in which its follower roller 25 remains out of contact with the arcuate surface of cam 16 when the transmission 15 rotates. For example, the lever 22 may be turned through full 180 degrees with respect to the position shown in the drawing. The position of plug 20 then remains unchanged and is controlled solely by the spring 30 and arresting means 31.

The apparatus shown in the drawing is utilized for alternately injecting two media one of which is supplied through the line 1*a* in the direction of arrow 37 and the other of which is drawn through the line 33 in the direction of arrow 38. When the follower roller 25 rocks the cam 16 and its carrier 26 in clockwise direction about the pivot axle 18, the segment 19 moves the plug 20 into the position shown in the drawing, i.e., in which the first medium is free to pass from the line 1*a* into the line 2 but the second medium 32 is prevented by the plug 20 from entering into the conduit 2. However, when the spring 30 is free to rock the parts 16, 26 in anticlockwise direction to the extent controlled by the arresting means 31, toothed member or segment 19 rotates the plug 20 into a position in which the line 1*a* is sealed from line 2 and the latter is open to line 33 whereby the second medium 32 is free to pass toward the pump 3 and thereover into the pressure line or conduit 11. Such mode of operation is utilized, for example, in treatment of a patient for widening or enlarging his blood vessels by alternately introducing oxygen through the conduit 1*a* and a liquid medicine 32 through the conduit 33, the transmission 15 insuring that the alternating dosages of oxygen and liquid treating medium 32 are injected at exactly predetermined time intervals. Alternately, the swinging movements of carrier member 26 under the influence of roller 25 may be utilized for admitting fluid from source 32*a* in which case the spring 30 causes the member 26 to move into a position permitting the flow of fluid from the source connected with conduit 1*a*. The pressure gauge 12 indicates the magnitude of pressures prevailing in the conduit 11 and prevents excessive rise or drop of such pressures.

The provision of two, three or more intake nipples 34 renders it possible to simultaneously control the injection of three or more different treating fluids. For example, the plugs 35 may be set in such a way that a fluid entering through the left-hand intake nipple 34 is injected alternately with the fluid 32, or that the fluid whose tank is connected to the right-hand intake nipple 34 is injected alternately with the fluids passing through the other two intake nipples 34. The plugs 35 may be adjusted by hand or by a non-represented automatic control system. In the position shown in the drawing, the central plug 35 permits the flow of fluid 32 into the conduit 2 while the other two plugs 35 seal the respective nipples 34. Thus, the novel insufflator is capable of controlling in a very simple and reliable manner the injection of several fluids in measured quantities, at fully controlled pressures, and at predetermined intervals of time.

The insufflator of my present invention may be utilized for injecting controlled quantities of oxygen; of blood circulation enhancing and blood vessel widening fluids in liquid form; of blood substitutes and nutrients for the tissue of a human or animal body; as well as of anticoagulants and antiseptics. The insufflation may occur directly into a punctured blood vessel or into any other part of a human or animal body. Since the pressure at which the injection of fluid occurs is generated by the pumping device 3, the tank or tanks from which one or more fluids are lead into the tube 2 may be maintained under any desired pressure and may contain large quantities of fluids. Thus, such tank or tanks need not be refilled while the insufflator is in actual use which would require interruption of the treatment. Consequently, the insufflator may be put to actual use for practically unlimited periods of time, e.g., it may be operated without interruption for several hours or for several days, if necessary. Among many other successful uses, the novel instrument has been proven as particularly useful in the treatment of localized bleeding by insufflation of oxygen as well as for treatment of all kinds of circulatory ailments.

The valve 1 and conduit 1*a* may be omitted if the insufflator is utilized for continuous injection of a single fluid. The supply line 2 is then connected directly to the cylinder containing oxygen or another substance utilized for a specific treatment. The valve 1 may be considered as consisting of several multi-way valves, namely, the one comprising the intake nipple 1*b*, the discharge nipple 1*c* and the plug 20, and three multi-way valves connected in parallel with valve 1*b*, 1*c*, 20 and each consisting of an intake nipple 34 and a plug 35. The plugs 35 are preferably actuated by hand.

The novel apparatus may be utilized for determining the pressures prevailing in the punctured artery or vein of a patient.

Without further analysis, the foregoing will go fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An insufflator comprising, in combination, at least one source of fluid to be insufflated; a pump; motor means comprising an infinitely variable transmission for driving the pump at variable rates of speed; valve means comprising at least one adjustable plug; first conduit means for connecting the source with said valve means;

second conduit means for connecting said valve means with the pump; third conduit means for delivering measured quantities of fluid at predetermined pressures from said pump into a patient's body; and an operative connection between said motor means and said plug for adjusting the latter whereby to alternately admit fluid from the source into said second conduit means, said operative connection comprising a transmission driven by the motor means, a disc rotated by said last mentioned transmission, a follower roller swingably mounted on said disc and rotatable therewith, a swingable cam in the path of said roller, a gear segment coupled with said cam, toothed means fixed to said plug and meshing with said segment for moving the plug in one direction when the cam is moved by said roller, and resilient means for moving the plug in the opposite direction when the cam is released by said roller.

2. An insufflator comprising, in combination, at least one source of fluid to be insufflated; a pump; electric motor means comprising an infinitely variable transmission for driving the pump at variable rates of speed; valve means comprising at least one plug; first conduit means for connecting the source with said valve means; second conduit means for connecting said valve means with the pump; third conduit means for delivering measured quantities of fluid at predetermined pressures from said pump into a patient's body; a pressure gauge connected with said third conduit means for indicating the pressures prevailing in said last mentioned conduit means, said pressure gauge comprising a scale and indicator means movable along said scale; an electrical connection between said gauge and said motor means for varying the rate of speed at which the pump is driven when the pressures in said third conduit means are outside a predetermined range, said electrical connection comprising a pair of stops on said scale at the opposite sides of said indicator means and a connection between each stop and said motor for increasing the rate of speed at which the pump is driven when the indicator means abuts one of said stops and for reducing the rate of speed at which the pump is driven when the indicator means abuts the other stop; and an operative connection between said motor means and said plug for adjusting the latter whereby to alternately admit and to prevent the flow of fluid from the source into said conduit means.

3. An insufflator comprising, in combination, at least two sources of fluid to be insufflated; a pump; motor means comprising an infinitely variable speed transmission for driving the pump at variable rates of speed; valve means comprising a plug for each of said sources; first conduit means for connecting each source with said valve means and each controlled by one of said plugs; second conduit means for connecting said valve means with the pump; third conduit means for delivering measured quantities of fluid at predetermined pressures from said pump into a patient's body; and an operative connection between said motor means and one of said plugs for automatically adjusting the latter whereby to alternately admit fluid from at least two different sources to said pump, said connection comprising a transmission driven by the motor means, a disc driven by said last mentioned transmission, a lever eccentrically mounted on said disc and swingable with respect thereto, a follower roller rotatably mounted on said lever, a carrier member swingable about an axis parallel with the axis of said roller, an arcuate cam adjustably fixed to said carrier member in the path of said roller, a first toothed member fixed to said carrier member, and a second toothed member fixed to said one plug and meshing with said first toothed member, said one plug being movable by the second toothed member into a position to admit at least one fluid from the respective first conduit means into said second conduit means when the roller engages said cam and swings the carrier member.

4. An insufflator comprising, in combination, at least two sources of fluid to be insufflated; a pump; motor means comprising an infinitely variable transmission for driving the pump at variable rates of speed; valve means comprising a plug for each of said sources; first conduit means for connecting each source with said valve means and each controlled by one of said plugs; second conduit means for connecting said valve means with the pump; third conduit means for delivering measured quantities of fluid at predetermined pressures from said pump into a patient's body; and an operative connection between said motor means and one of said plugs for automatically adjusting the latter whereby to alternately admit fluid from at least two different sources to said pump, said connection comprising a transmission driven by the motor means, a disc driven by said last mentioned transmission, a lever eccentrically mounted on said disc and swingable with respect thereto, a follower roller rotatably mounted on said lever, a carrier member swingable about an axis parallel with the axis of said roller, an arcuate cam adjustably fixed to said carrier member in the path of said roller, a first toothed member fixed to said carrier member, a second toothed member fixed to said one plug and meshing with said first toothed member, said one plug being movable by the second toothed member into a position to admit at least one fluid from the respective first conduit means into said second conduit means when the roller engages said cam and swings the carrier member, and constantly acting resilient means connected with said carrier member for urging same in a direction opposite to that in which the carrier member is swung by said roller whereby to move said one plug into another position in which the latter admits another fluid into said second conduit means.

5. An insufflator comprising, in combination, at least two sources of fluid to be insufflated; a pump; motor means comprising an infinitely variable speed transmission for driving the pump at variable rates of speed; valve means comprising a plug for each of said sources; first conduit means for connecting each source with said valve means and each controlled by one of said plugs; second conduit means for connecting said valve means with the pump; third conduit means for delivering measured quantities of fluid at predetermined pressures from said pump into a patient's body; and an operative connection between said motor means and one of said plugs for automatically adjusting the latter whereby to alternately admit fluid from at least two different sources to said pump, said connection comprising a transmission driven by the motor means, a disc driven by said last mentioned transmission, a lever eccentrically mounted on said disc and swingable with respect thereto, a follower roller rotatably mounted on said lever, a carrier member swingable about an axis parallel with the axis of said roller, an arcuate cam adjustably fixed to said carrier member in the path of said roller, a first toothed member fixed to said carrier member, a second toothed member fixed to said one plug and meshing with said first toothed member, said one plug being movable by the second toothed member into a position to admit at least one fluid from the respective first conduit means into said second conduit means when the roller engages said cam and swings the carrier member, constantly acting resilient means connected with said carrier member for urging same in a direction opposite to that in which the carrier member is swung by said roller whereby to move said one plug into another position in which the latter admits another fluid into said conduit means, and adjustable arresting means for controlling the extent to which the carrier member is swung by said resilient means.

6. An insufflator comprising, in combination, a pump having a pressure side and a suction side; motor means comprising an infinitely variable transmission for driving the pump at variable rates of speed; a pressure conduit

connected to the pressure side of said pump for delivering controlled quantities of a fluid into a patient's body; a supply conduit having a discharge end connected to the suction side of said pump and an intake end; a multiway valve having a discharge nipple connected to the intake end of said supply conduit, said valve further comprising at least two intake nipples each communicating with said discharge nipple and a plug for each intake nipple adjustably mounted in said valve for alternately sealing and unsealing the discharge nipple from the respective intake nipple; a source of fluid to be insufflated connected to at least one intake nipple; and an operative connection between said motor means and the plug associated with said one intake nipple, said connection comprising a transmission driven by the motor means, a disc driven by said last mentioned transmission, a lever eccentrically mounted on said disc and swingable with respect thereto, a follower roller rotatably mounted on said lever, a carrier member swingable about an axis parallel with the axis of said roller, an arcuate cam adjustably fixed to said carrier member in the path of said roller, a first toothed member fixed to said carrier member, a second toothed member fixed to said last mentioned plug and meshing with said first toothed member, said last mentioned plug being movable by the second toothed member into a first position when the roller engages said cam and swings the carrier member, and resilient means for constantly urging the carrier member in a direction opposite to that in which the latter is swung by said cam, the resilient member causing the second toothed member to move the last mentioned plug into a second position, said last mentioned plug sealing the respective source from said discharge nipple in one of said positions and permitting the flow of fluid to said discharge nipple in the other position.

7. An insufflator comprising, in combination, at least two sources of fluid to be insufflated; a pump; motor means comprising an infinitely variable speed transmission for driving the pump at variable rates of speed; valve means comprising a plug for each of said sources; first conduit means for connecting each source with said valve means and each controlled by one of said plugs; second conduit means for connecting said valve means with the pump; third conduit means for delivering measured quantities of fluid at predetermined pressures from said pump into a patient's body; and an operative connection between said motor means and one of said plugs for automatically adjusting the latter whereby to alternately admit fluid from at least two different sources to said pump, said connection comprising a transmission driven by the motor means, a disc driven by said last mentioned transmission, a lever eccentrically mounted on said disc and swingable with respect thereto, a follower roller rotatably mounted on said lever, a carrier member swingable about an axis parallel with the axis of said roller, an arcuate cam adjustably fixed to said carrier member in the path of said roller, a first toothed member fixed to said carrier member, and a second toothed member fixed to said one plug and meshing with said first toothed member, said one plug being movable by the second toothed member into a position to admit at least one fluid from the respective first conduit means into said second conduit means when the roller engages said cam and swings the carrier member, and said lever being swingable with respect to said disc into a position in which the roller is out of engagement with said cam.

8. An insufflator comprising, in combination, at least two sources of fluid to be insufflated; a pump; motor means comprising an infinitely variable speed transmission for driving the pump at variable rates of speed; valve means comprising a plug for each of said sources; first conduit means for connecting each source with said valve means and each controlled by one of said plugs; second conduit means for connecting said valve means with the pump; third conduit means for delivering measured quantities of fluid at predetermined pressures from said pump into a patient's body; and an operative connection between said motor means and one of said plugs for automatically adjusting the latter whereby to alternately admit fluid from at least two different sources to said pump, said connection comprising a transmission driven by the motor means, a disc driven by said last mentioned transmission, a lever eccentrically mounted on said disc and swingable with respect thereto, stop means fixed to said disc for maintaining the lever in a given position with respect to said disc, a follower roller rotatably mounted on said lever, a carrier member swingable about an axis parallel with the axis of said roller, an arcuate cam adjustably fixed to said carrier member in the path of said roller when the lever engages with said stop means, a first toothed member fixed to said carrier member, and a second toothed member fixed to said one plug and meshing with said first toothed member, said one plug being movable by the second toothed member into a position to admit at least one fluid from the respective first conduit means into said second conduit means when the roller engages said cam and swings the carrier member, and said lever being swingable away from engagement with said stop means into a position in which the roller is out of engagement with said cam.

9. An insufflator comprising, in combination, a pump having a pressure side and a suction side; motor means comprising an infinitely variable transmission for driving the pump at variable rates of speed; a pressure conduit connected to the pressure side of said pump for delivering controlled quantities of a fluid into a patient's body; a supply conduit having a discharge end connected to the suction side of said pump and an intake end; a multiway valve having a discharge nipple connected to the intake end of said supply conduit, said valve further comprising at least two intake nipples each communicating with said discharge nipple and a plug for each intake nipple adjustably mounted in said valve for alternately sealing and unsealing the discharge nipple from the respective intake nipple; a source of fluid to be insufflated connected to at least one intake nipple and an operative connection between said motor means and the plug associated with said one intake nipple, said connection comprising a transmission driven by the motor means, a disc driven by said last mentioned transmission, a lever eccentrically mounted on said disc and swingable with respect thereto, a follower roller rotatably mounted on said lever, a carrier member swingable about an axis parallel with the axis of said roller, an arcuate cam adjustably fixed to said carrier member in the path of said roller, and means for transmitting swinging movements of said carrier member to said last mentioned plug whereby to move the latter into a pair of positions in one of which fluid is admitted from the respective source into said discharge nipple when the roller engages the cam and swings the carrier member in one direction and in the other of which the last mentioned plug seals the respective source from said discharge nipple, the operative connection further comprising resilient means for constantly urging the carrier member in a direction opposed to that in which the carrier member is swung by said cam when the latter engages with said roller whereby the resilient means constantly tends to move the last mentioned plug into said other position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,553,859	Hein	Sept. 15, 1925
1,615,643	Mickey	Jan. 25, 1927
2,434,802	Jacobs	Jan. 20, 1948
2,449,678	Stallcup	Sept. 21, 1948
2,483,924	Moulinier	Oct. 4, 1949

FOREIGN PATENTS

290,364	Italy	Nov. 17, 1931