Nov. 27, 1956 W. E. FOLLAND ET AL 2,771,878

INTRAVENOUS INFUSION SYSTEM

Filed Aug. 27, 1952

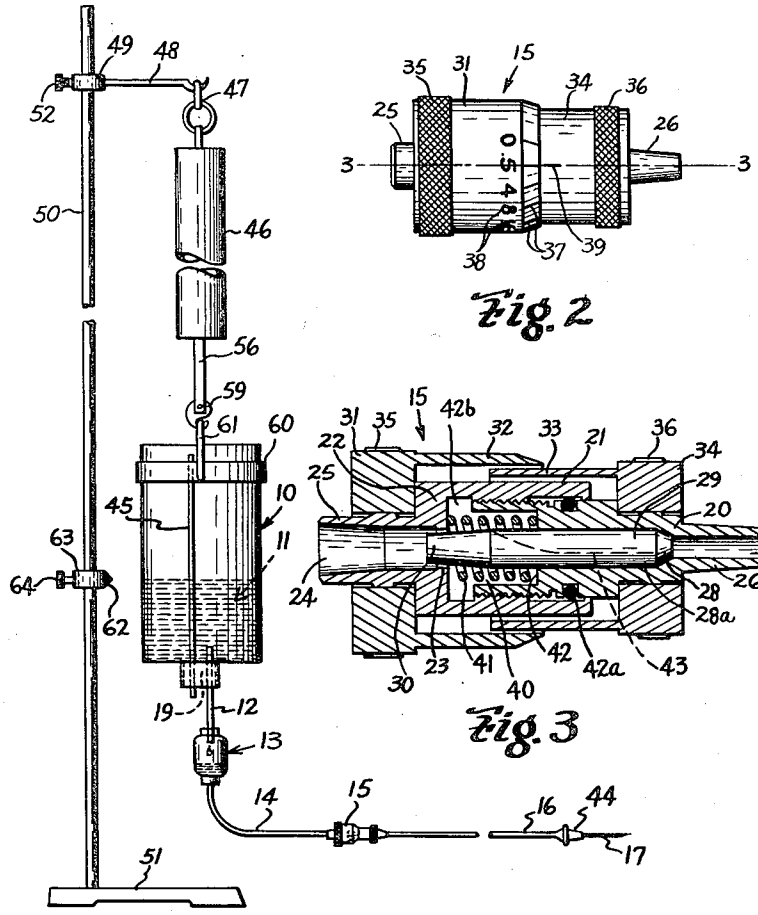

Fig. 1

Fig. 2

Fig. 3

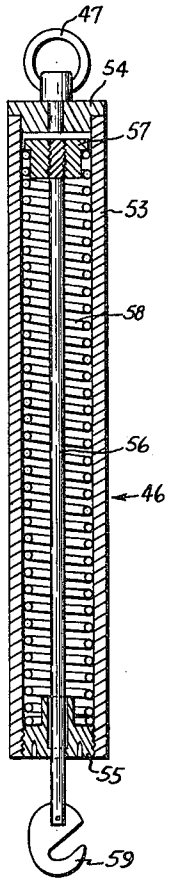

Fig. 4

INVENTORS
WILLARD E. FOLLAND
CHARLES A. ELLIS

BY Louis K. Gagnon
ATTORNEY

United States Patent Office 2,771,878 Patented Nov. 27, 1956

2,771,878

INTRAVENOUS INFUSION SYSTEM

Willard E. Folland, Williamsville, N. Y., and Charles A. Ellis, Southbridge, Mass., assignors to American Optical Company, Southbridge, Mass., a voluntary association of Massachusetts

Application August 27, 1952, Serial No. 306,636

18 Claims. (Cl. 128—214)

This invention relates to improvements in intravenous infusion systems and has particular reference to novel means and method of administering a fluid parenterally by the intravenous method while maintaining a substantially constant fluid pressure and rate of flow during the introduction of the fluid into the blood stream.

One of the principal objects of this invention is to provide improved means and method of intravenous feeding embodying equipment so constructed and arranged as to permit a supply of fluid to be fed at a controlled uniform rate and constant pressure through a conduit into the blood stream of a patient without the requirement of close supervision.

Another object is to provide an infusion system comprising a fluid container adapted to be suspended above a patient and from which a fluid is allowed to flow by gravital force through conduit means and through a metering device into the blood stream of the patient, said metering device controlling the rate of flow of the fluid through the conduit means, and said container being connected with means for maintaining a substantially constant fluid level above the heart of the patient throughout the transfusion.

Another object is to provide an infusion system of the above character wherein said metering device is manually adjustable to control the size of the orifice through which the fluid passes whereby the rate of flow of the fluid may be varied.

Another object is to provide an infusion system of the above character wherein the fluid container is suspended from supporting means therefor by a spring device, said spring device embodying an elongated cylinder having therein a reciprocal member which is normally held within the cylinder by means of a compression spring of known compression characteristics and which is adapted to be drawn outwardly of the cylinder by the weight of the container and fluid therein, the compression characteristics of said spring being controlled whereby the spring will act to draw inwardly the reciprocal member and simultaneously raise the container, and the fluid therein an amount sufficient to maintain a substantially constant fluid level as the fluid is drawn out of the container during the transfusion process.

Another object is to provide novel means and method of intravenous infusion embodying equipment which is comparatively simple in its construction, efficient and automatic in its operation.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a front elevational view of an infusion system embodying the invention;

Fig. 2 is an enlarged front elevational view of a metering device;

Fig. 3 is an enlarged sectional view through the metering device taken substantially on line 3—3 of Fig. 3; and

Fig. 4 is a vertical sectional view through the fluid level controlling device.

The introduction of selected fluids directly into the blood system of patients has become a recognized therapeutic practice. Parenteral therapy is generally found advisable in any one of four uses as follows:

1. To replace lost blood.
2. To correct deviations from normal acid base balance.
3. To provide food energy when the gastrointestinal tract can not be used.
4. To introduce a drug or chemotherapeutic agent.

In administering fluids for any one of the four above purposes directly into the blood stream of a patient, it is extremely important that the rate of introduction of the fluid be carefully controlled because of the direct affect upon the patient. Heretofore it has been the practice to count the drops of fluid passing through a visible indicator which is located between the reservoir and the patient's venous system. This requires practically constant supervision and in most previously known instances necessitated the used of pinch clamps acting directly upon the conduit whereby the rate of flow could be controlled. Numerous experiments and general usage have proven that pinch clamps are unreliable and that the effect of lowering the level of the fluid and yielding of the plastic conduit acted upon by the pinch clamps both operate to decrease the rate of flow over a selected period of time below the desired rate. However, since such pinch clamps are dependent upon the physical characteristics of the conduit they do not satisfactorily control the flow rate over a desired period of time nor is the rate of flow from a constant immovable supply satisfactory. Thus, during a single transfusion, due to the fact that the level of the fluid is constantly changing, it can be seen that frequent attention and adjustment of the equipment is necessitated. Other detrimental factors include the fact that plastic tubing such as is generally used for the conduits may be unsatisfactory for use with conventional pinch clamps.

The present invention overcomes the deficiencies of known present intravenous infusion systems by providing a positively functioning calibrated metering device which is adapted to function co-operatively with a fluid level controlling device for insuring substantially constant fluid pressure and flow rate during an entire infusion procedure. With a system of the present invention the introduction for example of controlled amounts of drugs for considerable periods of time are practical with a minimum of attention being necessary. Such a device is particularly advantageous during lengthy operations and also makes available the use of certain materials which where not used heretofore because of lack of satisfactory control during the administration thereof.

Referring more particularly to the drawing wherein like characters of reference designate like parts throughout the several views, the preferred form of the invention embodies a reservoir or container **10** which contains an amount of a selected fluid **11** which is adapted to flow outwardly of the container **10** through a first tubing section **12** into a drip bulb or sight chamber **13**, and from the drip bulb **13** through a second tubing section **14** to a metering device **15**, from which it is allowed to flow at a controlled flow rate through a third section of tubing **16** and a needle **17** into the blood stream of a patient.

The container **10** is preferably transparent and substantially cylindrical in shape. It is preferably sealed at one end and provided with a plug or stopple **19** at the other end. Within the container **10** is the fluid **11** which may be of any selected type such as plasma, albumin or amino acids which are used in the case of fulfilling necessary protein requirements, dextrose which may be used to provide a patient with desired caloric requirements,

and vitamins for providing necessary organic compounds. When it is desired to intravenously administer analgesics and sedatives, the fluid 11 may be ethyl alcohol, procaine hydrochloride, or d-tubocurarine chloride solution. Other fluids also may be used with the presently described equipment for the above and other uses.

The stopple 19 is provided with two openings, one for receiving a vent tube 45 and the other for receiving one end of the first tubing section 12, the other end of the tubing section 12 being inserted in one end of the drip bulb 13, the inside diameter of the tubing section 12 as well as the tubing sections 14 and 16 being controlled so as to provide the desired most efficient flow characteristics. The tubing may be formed of rubber or plastic and should be readily pliable. The drip bulb 13 is also transparent so that when it is suspended from the container 10, the dripping of the fluid 11 from the tubing section 12 into the bulb 13 can be seen and the drops counted. It is important that the flow of fluid be very carefully controlled. In fact, second in importance only to the pyrogenic reaction factor is circulatory overload which causes "speed shock" and is caused by improper administration of fluids. Therefore, an operator must, by present known methods, continually control the rate of flow by regulating the number of drops per minute in the drip bulb 13.

Supplanting the conventional safety clamps or clips for regulating the flow of fluid 11 is the metering device 15 which is connected to the other end of the drip bulb 13 by the second section of tubing 14. The metering device 15, as shown in Figs. 2 and 3, comprises a central elongated cylinder 20 which has one end threadedly inserted within one end of a tubular member 21. The other end of the tubular member 21 is sealed by the end portion 22 and is provided therethrough with a restricted tapered circular opening 23 which communicates with the interior 24 of a female hub 25 formed integral with and extending outwardly from the tubular member 21.

The outer end of the cylindrical member 20 is formed with a tapered outwardly extending male hub 26 and is provided with a bore 27 therein of relatively small diameter. The bore 27 tapers as shown at 28 into a larger bore 28*a* in which is tightly fitted a stop member such as spindle or pin 29. One end of the pin 29 is provided with a tapered portion 30 which is located within the tapered opening 23, the angle of taper of the portion 30 being substantially the same as the angle of taper of the walls of the opening 23.

Thus, it is apparent that as the cylindrical member 20 is threaded into or out of the tubular member 21, the tapered end 30 of the pin 29 will move longitudinally of the device within the opening 23 and will thus control the size of the clear unblocked area within the opening 23.

The means for rotating the tubular member 21 comprises a cover or shield 31 which is tightly mounted over a portion of the hub 25 and which has an annular portion 32 which extends into overlying relation with a similar annular portion 33 formed on a cover or shield 34 which is tightly mounted on the cylindrical member 20. Each of the covers 31 and 34 are provided therearound with circular knurled areas 35 and 36 respectively whereby the parts may be easily gripped and rotated relative to one another to adjust the tapered portion 30 of the pin 29 in the opening 23. Means such as a scale 37 and numeric indications 38 (Fig.2) are provided on the outer surface of the cover 31 for registering with an indicating line 39 on the cover 34 to visually indicate to an operator the exact adjustment of the device.

Since the device must necessarily be as sensitive as possible, any looseness such as might exist in the threads joining the member 20 and 21 is undesirable. Therefore, the bore 28*a* in the cylindrical member 20 is provided with an enlarged portion 40 in which is located a compression spring 41, the spring 41 being mounted over the pin 29 with one end engaging the shoulder 42 formed by the enlarged portion 40 of the bore 28*a* and with its other end engaging the end portion 22 of the tubular member 21. Thus, constant pressure is applied to the cylindrical member 20 and tubular member 21 which will automatically and continuously take up any slack in the threads.

The fluid 11 in passing into the metering device 15 from the tubing section 14 enters through the interior 24 of the female hub 25 in which the end of the tubing section 14 is located and flows through the opening 23 in controlled amounts in accordance with the adjusted position of the tapered end 30 of the pin 29. The fluid 11 thus enters the chamber 42*b* provided between the members 20 and 21 and passes through the spring 41 into an elongated slot 43 formed in the pin 29. A resilient ring or gasket 42*a* is positioned around the cylindrical member 20 and engages the adjacent portion of the tubular member 21 to prevent leakage of fluid which might pass through the threads. From the slot 43, the fluid flows through the bore 27 into the tubing section 16, the end of which is located on the male hub 26, to the needle 17 which is attached to the tubing section 16 by means of a conventional adapter 44.

The rate of introduction of the fluid into the veins of a patient, however, must be carefully controlled as stated above. For example, using an eighteen-gauge needle 17, about 16 cc.'s or 60–75 drops of fluid per minute is preferred for administering a protein, caloric, or vitamin solution since the rate of introduction should be not greater than the metabolic rate. In any event not more than one liter per hour should be introduced in the average adult. By rotating the covers 31 and 34, the rate of flow can be adjusted as described from the zero (or shut off) position to 16 cc.'s per minute as indicated by the scale 37.

It is apparent that if the container 10 is placed above the patient that flow of the fluid 11 will naturally result. However, it is known that the normal blood pressure of a patient is measurable and in order to compensate for or overcome back pressure into the system from the veins, or the arteries if used, the container must be raised high enough to provide enough additional pressure. Also, as the level of the fluid 11 in the container 10 drops during the administering of the fluid into a patient's blood stream, the pressure thereof would consequently decrease if the container was maintained in a fixed position.

Means is provided for automatically raising the container 10 as the fluid 11 flows therefrom. In prior art methods of intravenous therapy, this was done by manually raising the container at frequent intervals. In accordance with the present invention, however, the container 10 is suspended from a spring device 46 which is, in turn, suspended by means of links 47 from an arm or hook 48 adjustably mounted by means of a collar 49 on a vertically extending post 50 carried by a stand 51. The collar 49 is initially adjusted vertically on the post 50 and locked in adjusted position thereon by means of a locking screw 52. The spring device 46 comprises a hollow cylinder 53 (Fig. 4) which is sealed by plugs 54 and 55 at the upper and lower ends respectively. Within the cylindrical member 53 is positioned a reciprocal rod 56 having its inner end provided with a stepped hub 57 and having its opposed end extending through the lower plug 55 in a direction toward the container 10. Positioned within the cylindrical member 53 in encircling relation with the rod 56 is a coiled compression spring 58 which has one end located in engagement with the inner end of the plug 55 and has its opposed end engaging the hub 57 carried by rod 56. Thus, the spring 58 continually urges the rod 56 inwardly of the cylindrical member 53. The outer end of the rod 56 is provided with a suitable hook 59. The container 10 is provided with an encircling band 60 to which is pivotally secured a bail 61 which is adapted to be connected with the hook 59 whereby the container 10 can be suspended from the spring device 46.

It is apparent that when the container **10** is provided with a substantial amount of fluid **11**, the weight thereof will cause the rod **56** to be drawn outwardly of the cylindrical member **53** against the inherent tension of the spring **58**. However, as the fluid **11** flows from the container **10**, the weight thereof will consequently decrease and the spring **58** will thereby be enabled to draw the rod **56** upwardly and thus cause a raising of the container **10**. An indicator or pointer **62** is provided on a collar **63** which is adapted to be adjustable upwardly or downwardly on the post **50** and locked by means of a locking screw **64**. The pointer is initially adjusted to be aligned with the fluid level at the start of the infusion. As the container **10** is raised during the infusion, the level of the fluid should remain constant and in alignment with the pointer **62**. To provide for this, the compression spring **58** in the spring device **46** is accurately calibrated so as to have a spring weight substantially equal to the rate of fluid volume per unit height. Thus, during the infusion, the level of the fluid will be maintained substantially and in alignment with the pointer **62** and thus the fluid pressure will be also maintained constant throughout the procedure.

It is obvious from the foregoing that an improved intravenous infusion system is provided which is extremely efficient and which requires a minimum of supervision.

From the foregoing description, it will be apparent that all of the objects and advantages of the invention have been accomplished. However, it will also be apparent that many changes may be made in the arrangement of parts shown and described without departing from the spirit of the invention. Therefore, it is to be understood that all matter shown or described should be interpreted as illustrative and not in a limiting sense.

We claim:

1. Apparatus for use in intravenous infusion comprising a supply of fluid to be administered into the blood stream of a patient, conduit means for connecting said supply of fluid with the blood system of the patient, said conduit means embodying means for controlling the rate of flow of said fluid therethrough, and means associated with said fluid supply and functioning automatically and proportionately with the flow of fluid therefrom to maintain said fluid at a substantially constant established level during infusion.

2. In an intravenous infusion system embodying a container carrying a supply of fluid to be gravitally fed from said container through conduit means into the blood stream of a patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit, and adjusting means connected with said container for automatically maintaining said fluid substantially at a given level during infusion.

3. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of said fluid gravitally to said patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit means, and adjusting means connected with said supply of fluid and functioning proportionately with the flow of fluid therefrom for automatically maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

4. An intravenous infusion system comprising a container for carrying a supply of fluid to be administered into the blood stream of a patient and adapted to be positioned so that the level of the fluid is initially at a predetermined height above the heart of the patient, conduit means connected at one end with said container and having its other end adapted to be connected with the blood system of said patient, a metering device inserted in said conduit means for controlling the rate of flow of said fluid passing from said container to said patient through the conduit means, and level controlling means connected with said container for automatically adjusting the position of the container as the level of the fluid in the container drops during infusion whereby said level will continually be maintained at substantially the same predetermined height above the patient.

5. An intravenous infusion system comprising a container for carrying a supply of fluid to be administered into the blood stream of a patient and adapted to be positioned so that the level of the fluid is initially at a predetermined height above the heart of the patient, conduit means connected at one end with said container and having its other end adapted to be connected with the blood system of said patient, a metering device inserted in said conduit means for controlling the rate of flow of said fluid passing from said container to said patient through the conduit means, and level controlling means connected with said container for automatically adjusting the position of the container proportionately with the flow of fluid therefrom whereby said level will be constantly maintained at substantially the same predetermined height above the patient.

6. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of said fluid to said patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit means and comprising a substantially tubular metering unit having an orifice in each end thereof whereby fluid will pass therethrough and a stop member adjustable with respect to one of said orifices to control effective size of said orifice and thereby control the rate of flow by regulating the amount of fluid permitted to pass through the orifice during a given time interval, and adjusting means connected with said supply of fluid for maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

7. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of said fluid to said patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit means and comprising a substantially cylindrical member having a longitudinal bore therethrough, a substantially tubular member attached at one end to said cylindrical member and having a restricted orifice at its other end, a stop member carried by said cylindrical member and adapted to be located adjacent said orifice, said cylindrical member and tubular member being adjustable toward and away from one another to locate said stop member in desired adjusted position with respect to said orifice to control the amount of fluid permitted to pass through said orifice during a given time interval and thereby control the rate of flow of said fluid, and adjusting means connected with said supply of fluid for maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

8. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of said fluid to said patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit means and comprising a substantially cylindrical member having a longitudinal bore therethrough, a substantially tubular member threadedly attached at one end to said cylindrical member and

having a restricted orifice at its other end, a stop member carried by said cylindrical member and adapted to be located adjacent said orifice, a cover mounted on one of said members and having indicating means thereon and a second cover on the other of said members having a scale thereon registering with said indicating means on said first cover, said cylindrical member and tubular member being adjustable toward and away from one another to locate said stop member in desired adjusted position with respect to said orifice in accordance with said scale reading to control the amount of fluid permitted to pass through said orifice during a given time interval and thereby control the rate of flow of said fluid, and adjusting means connected with said supply of fluid for maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

9. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of said fluid to said patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit means and comprising a substantially cylindrical member having a longitudinal bore therethrough, a substantially tubular member threadedly attached at one end to said cylindrical member and having a restricted orifice at its other end, compression means connected with said cylindrical and tubular members for taking up slack in the threaded connection between said members, a stop member carried by said cylindrical member and adapted to be located adjacent said orifice, a cover mounted on one of said members and having indicating means thereon and a second cover on the other of said members having a scale thereon registering with said indicating means on said first cover, said cylindrical member and tubular member being adjustable toward and away from one another to locate said stop member in desired adjusted position with respect to said orifice in accordance with said scale reading to control the amount of fluid permitted to pass through said orifice during a given time interval and thereby control the rate of flow of said fluid, and adjusting means connected with said supply of fluid for maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

10. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patent for passage of said fluid to said patient, control means connected with said conduit means for conrtolling the rate of flow of said fluid through said conduit means, and adjusting means connected with said supply of fluid and comprising a spring device from which said supply of fluid is suspended and which is calibrated to function proportionately with the flow of fluid from said supply for automatically maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

11. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of said fluid to said patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit means and comprising a substantially tubular metering unit having an orifice in each end thereof whereby fluid will pass therethrough and a stop member adjustable with respect to one of said orifices to control effective size of said orifice and thereby control the rate of flow by regulating the amount of fluid permitted to pass through the orifice during a given time interval, and adjusting means connected with said supply of fluid and comprising a spring device from which said supply of fluid is suspended and which is calibrated to function proportionately with the flow of fluid from said supply for automatically maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

12. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of said fluid to said patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit means and comprising a substantially cylindrical member having a longitudinal bore therethrough, a substantially tubular member attached at one end to said cylindrical member and having a restricted orifice at its other end, a stop member carried by said cylindrical member and adapted to be located adjacent said orifice, said cylindrical member and tubular member being adjustable toward and away from one another to locate said stop member in desired adjusted position with respect to said orifice to control the amount of fluid permitted to pass through said orifice during a given time interval and thereby control the rate of flow of said fluid, and adjusting means connected with said supply of fluid and comprising a spring device from which said supply of fluid is suspended and which is calibrated to function proportionately with the flow of fluid from said supply for automatically maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

13. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of said fluid to said patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit means and comprising a substantially cylindrical member having a longitudinal bore therethrough, a substantially tubular member threadedly attached at one end to said cylindrical member and having a restricted orifice at its other end, a stop member carried by said cylindrical member and adapted to be located adjacent said orifice, a cover mounted on one of said members and having indicating means thereon and a second cover on the other of said members having a scale thereon registering with said indicating means on said first cover, said cylindrical member and tubular member being adjustable toward and away from one another to locate said stop member in desired adjusted position with respect to said orifice in accordance with said scale reading to control the amount of fluid permitted to pass through said orifice during a given time interval and thereby control the rate of flow of said fluid, and adjusting means connected with said supply of fluid and comprising a spring device from which said supply of fluid is suspended and which is calibrated to function proportionately with the flow of fluid from said supply for automatically maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

14. An intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated, conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of said fluid to said patient, control means connected with said conduit means for controlling the rate of flow of said fluid through said conduit means and comprising a substantially cylindrical member having a longitudinal bore therethrough, a substantially tubular member threadedly attached at one end to said cylin-

drical member and having a restricted orifice at its other end, compression means connected with said cylindrical and tubular members for taking up slack in the threaded connection between said members, a stop member carried by said cylindrical member and adapted to be located adjacent said orifice, a cover mounted on one of said members and having indicating means thereon and a second cover on the other of said members having a scale thereon registering with said indicating means on said first cover, said cylindrical member and tubular member being adjustable toward and away from one another to locate said stop member in desired adjusted position with respect to said orifice in accordance with said scale reading to control the amount of fluid permitted to pass through said orifice during a given time interval and thereby control the rate of flow of said fluid, and adjusting means connected with said supply of fluid and comprising a spring device from which said supply of fluid is suspended and which is calibrated to function proportionately with the flow of fluid from said supply for automatically maintaining the level of said fluid substantially constant at said given distance above the patient during infusion.

15. Apparatus for use in intravenous infusion comprising a container for carrying a supply of fluid to be administered into the blood stream of a patient, conduit means for connecting said container with the blood system of the patient, and a support for said container including a spring and a stop against which the spring is compressed by the weight of the container, and the compression characteristic of the spring being so controlled that the spring functions automatically and proportionately with the flow of fluid from the container to maintain said fluid at a substantially constant established level during infusion.

16. Apparatus for use in an intravenous infusion system embodying a supply of fluid to be administered into the blood stream and conduit means for connecting said supply of fluid with the patient's blood system, said apparatus comprising a compression spring device by which said supply of fluid is supported and means controlling the compression of said spring device so that it will function proportionately with the flow of fluid from said supply for automatically maintaining the level of said fluid substantially constant at a given distance above the patient during infusion.

17. In an intravenous infusion system embodying a supply of fluid supported with the level thereof at a

given distance above a patient to be treated having conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of fluid to said patient, control means connecting with said conduit means for controlling the rate of flow of said fluid through said conduit means and comprising a first member having a hollow bore and a second member having a restricted orifice communicating with said bore, a stop carried by said first member and having a portion adapted to be located adjacent said orifice, said second member having the restricted orifice and said first member being rotatable toward and away from one another to locate said stop in desired adjusted position with respect to said restricted orifice to control the amount of fluid permitted to pass through said orifice during a given time interval and thereby control the rate of flow of said fluid.

18. Apparatus for use in an intravenous infusion system embodying a supply of fluid supported with the level thereof at a given distance above a patient to be treated having conduit means connected with said supply of fluid and adapted to be connected with the blood stream of said patient for passage of fluid to said patient, said apparatus comprising control means connecting with said conduit means for controlling the rate of flow of said fluid through said conduit means and including a first member having a hollow bore and a second member having a restricted orifice communicating with said bore, a stop carried by said first member having a long tapered portion adapted to be located within said orifice, said members interfitting with each other and arranged to be rotated through proportionately large angular amounts to move said stop proportionately small amounts to finely adjust said stop in directions toward and away from said restricted orifice to accurately control the amount of fluid permitted to pass through said orifice during a given time interval and thereby control the rate of flow of said fluid.

References Cited in the file of this patent

UNITED STATES PATENTS

518,009	Springer	Apr. 10, 1894
1,360,833	Vuilleumier	Nov. 30, 1920
1,593,172	Heatherington	July 20, 1926
2,014,314	Defenbaugh	Sept. 10, 1935
2,470,481	Freeman	May 17, 1949
2,626,631	Hotton et al.	Jan. 27, 1953