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[56]

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[54] TUBE PINCHER FOR INTRAVENOUS ADMINISTRATION

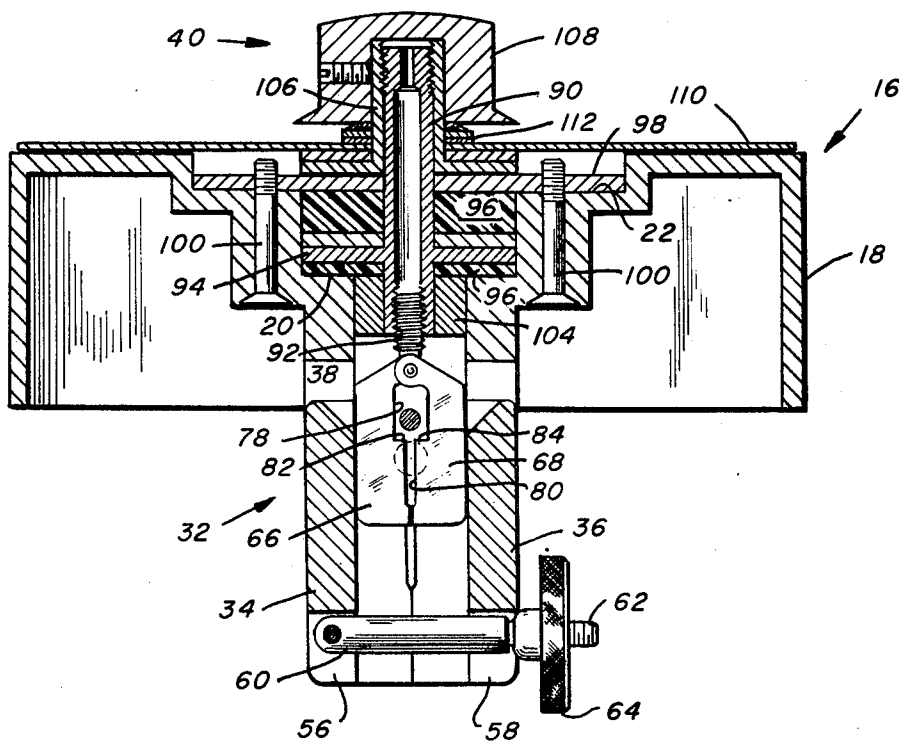
7 Claims, 10 Drawing Figs.

[52] U.S. Cl..... 137/556,
251/7

[51] Int. Cl. F16k 37/00, 251/7

[50] **Field of Search**..... 137/553,
556; 251/7-9

ABSTRACT: A pincher for flexible tubing in an intravenous administration set has a pinching element slidably disposed between two tubing holders receiving and grasping the flexible tubing. Transverse movement of the pinching element over the flexible tubing pinches the tubing to effectuate therein a circular orifice of desired size as a function of flow therethrough. The apparatus also includes calibrated scales for setting the tube pincher at the prescribed drip rate.



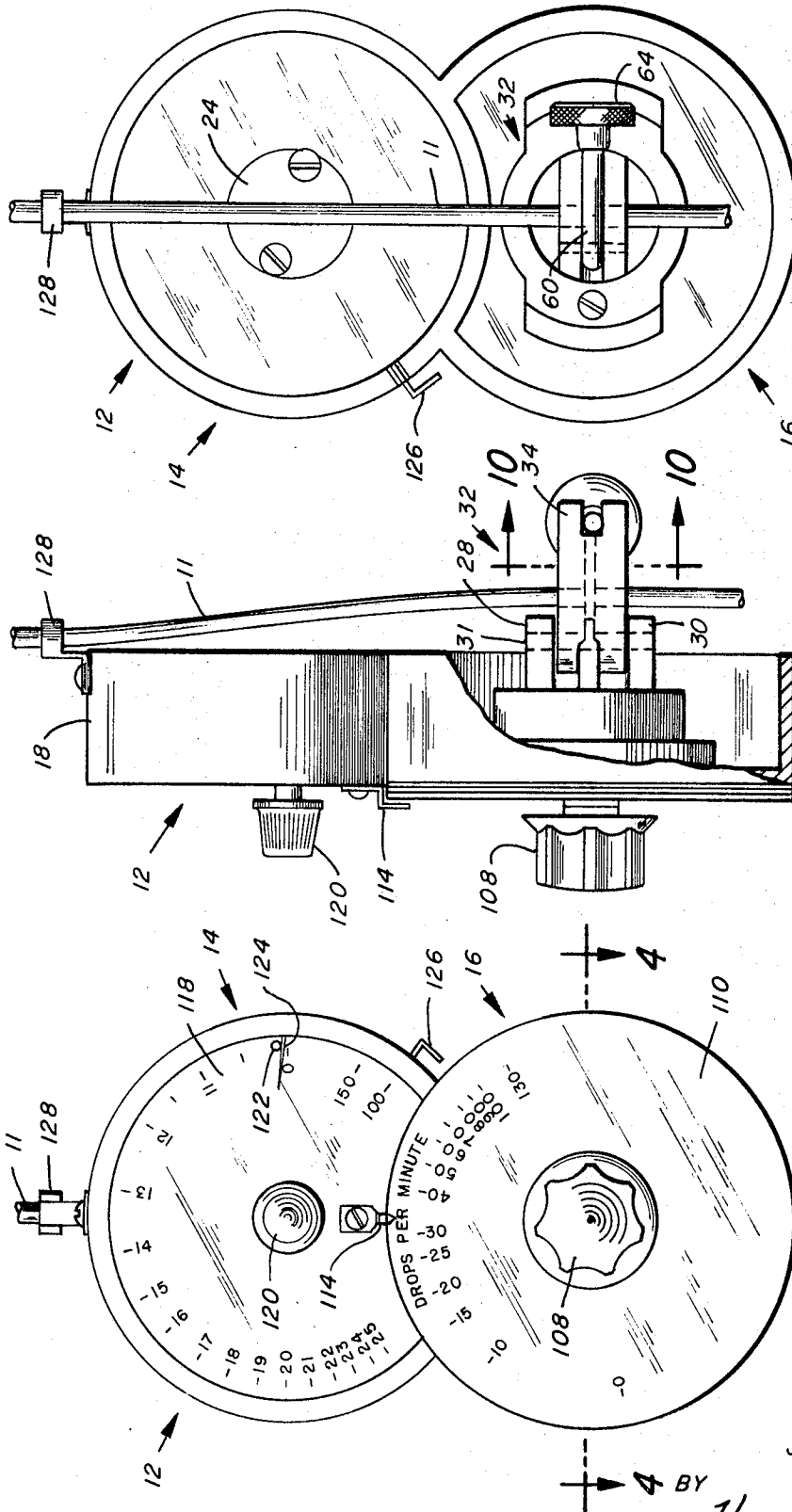


FIG. 3

FIG. 2

FIG. 1

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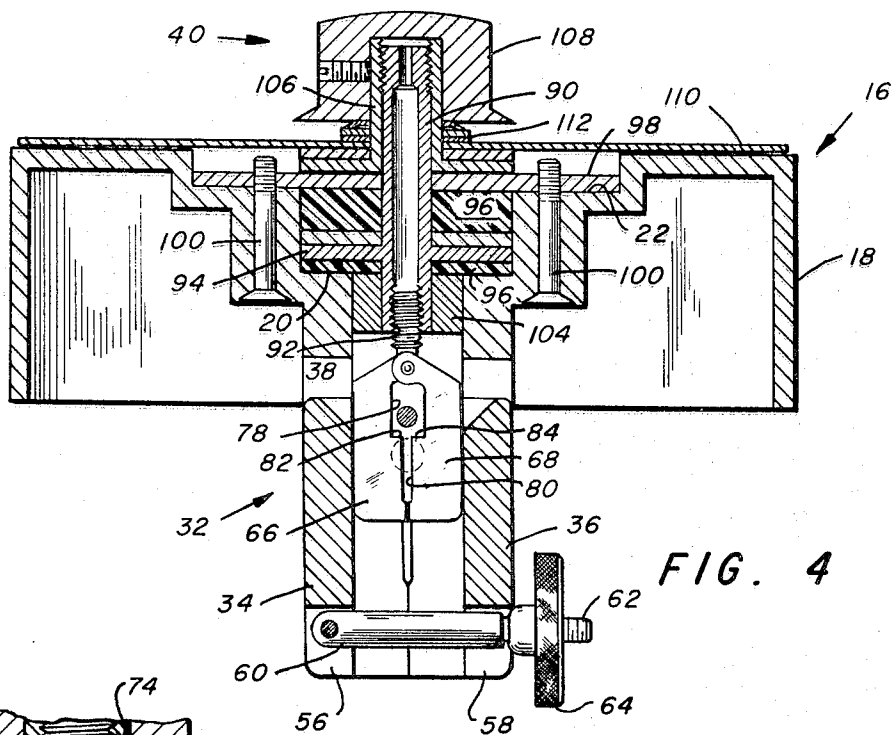


FIG. 4

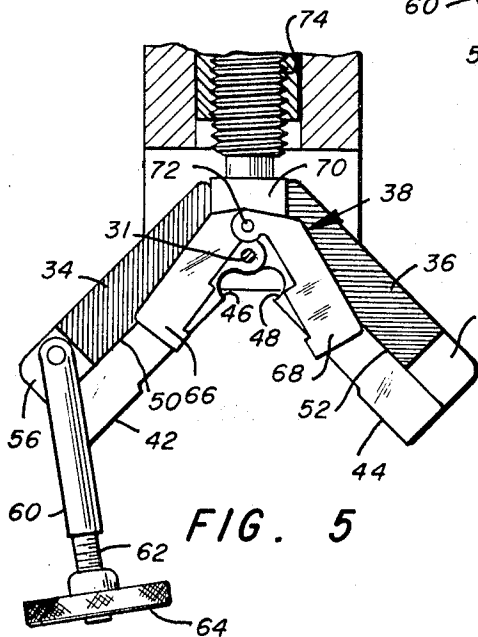


FIG. 5

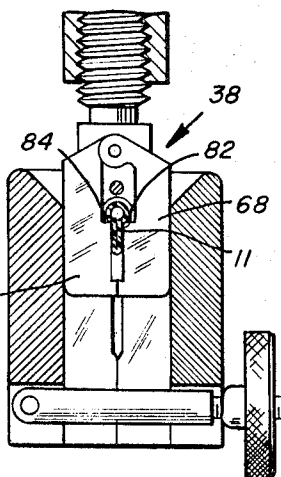


FIG. 6

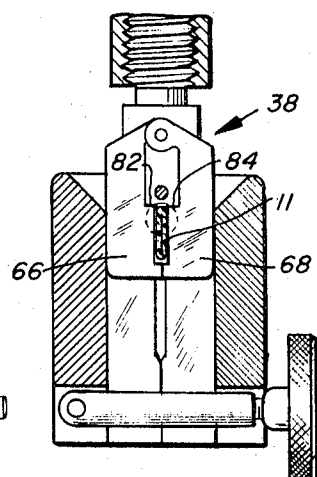


FIG. 7

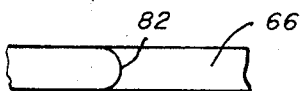


FIG. 8

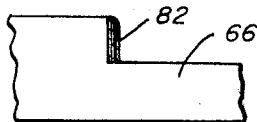


FIG. 9

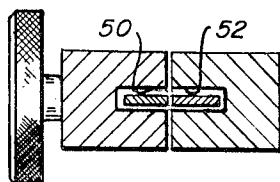


FIG. 10

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TUBE PINCHER FOR INTRAVENOUS ADMINISTRATION

BACKGROUND OF THE INVENTION

This invention relates to intravenous feeding and more particularly to a means for adjustably controlling the drip rate of the intravenous liquid. Intravenous administration sets used on the market today usually comprise a unitary sealed and sterile package comprising a drip chamber, a plastic delivery tube leading from the drip chamber to the patient with an adjustable clamp on the tube, the flow of which may be regulated to a desired rate by the attending physician or nurse. Regulation is accomplished by counting the drops per minute and adjusting the clamp to that prescribed. This is not only time consuming but is considered to be inaccurate and susceptible to mistakes.

Furthermore the plastic tubing in use has a memory characteristic in that after any pinching thereof the tube tends to return slowly to its original conformation. In the type of clamps presently used, the clamp is pinched directly into the tube according to a desired rate of flow. However, the memory characteristic of the tube causes shrinkage of the orifice during the first 30 minutes or so after adjustment has been made. This shrinkage of the orifice reduces the flow rate considerably thereby necessitating further and frequent adjustment.

It is therefore an object of this invention to present an intravenous tube pincher which operably transverses the plastic tubing.

It is a further object of this invention to present a tube pincher for intravenous feeding which presents an adjustable orifice of substantially constant circular form for flow of liquid therethrough.

It is still a further object of this invention to present a tube pincher for intravenous feeding having means thereon for properly setting the tube pincher at the prescribed drip rate.

It is a further object of this invention to present a tube pincher with setting means thereon which can be directly attached to the plastic tubing of the administration set without further support thereof.

SUMMARY OF THE INVENTION

Generally the invention presents pivotal confronting jaws having notches thereon which cooperate to receive and hold the flexible tubing. Slidably interposed in the jaws and bisecting the notches is a pinching element containing therein a narrow pinch slot in communication with a wide slot through which the tube passes. Transverse movement of the pinch slot across the tube pinches a portion of the tube and effectuates in the remaining portion a substantially circular orifice. In addition to the pincher element the apparatus includes a stopwatch and a calibrated indicia scale to facilitate in the proper transverse positioning of the pinch element on the tube for a given flow rate.

Hence it has been found that if the plastic tubing rather than being pinched directly across its entire width is pinched on the side by having the pincher element transverse across the tube a substantially circular orifice is formed which achieves a stable flow rate from the beginning to the end of the intravenous feeding.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front plan view of the apparatus.

FIG. 2 is a side view of the apparatus showing a partial cutaway thereof.

FIG. 3 is a rear view of the apparatus.

FIG. 4 is a cross-sectional view of the apparatus taken along lines 4-4 of FIG. 1.

FIG. 5 is a partial sectional view of the apparatus showing the jaws and the pinching element in the open position.

FIG. 6 is a partial cross-sectional view of the apparatus showing the pincher element drawn upwardly partially transversed over the flexible tubing.

FIG. 7 is a partial view of the apparatus showing the pincher element drawn upwardly as in the no-flow position.

FIG. 8 is a partial cross-sectional view of the pincher blades showing the specific cross-sectional shape of the edge thereof.

FIG. 9 is a partial frontal view of the blade which is an element of this invention showing the curvature of the inner corner thereof.

FIG. 10 is a partial cross-sectional view of the apparatus taken along the lines 10-10 of FIG. 2.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

The apparatus is directly attached to flexible tubing 11 extending between the drip chamber of an intravenous administration set (not shown) and the patient's arm and includes a unitary moulded case 12 of lightweight material such as plastic. As can be best seen in FIG. 1, the case has an upper compartment 14 and a lower compartment 16 both of circular configuration and having around the periphery thereof a rearwardly extending flange 18. The two compartments are in line to give the case a "figure 8" shape as is shown in FIG. 3. The upper compartment 14 contains a stopwatch 24 and the lower compartment 16 contains pinching assembly 32.

Looking now at the cross-sectional view shown in FIG. 4, the lower compartment 16 has about the center thereof concentric recesses of inwardly diminishing diameter which create flat horizontal annular stair-stepped ridges 20 and 22. Inwardly of the ridge 20 the lower compartment 16 further contains about the circle thereof an annular hole 26.

Aptly shown in FIG. 2 extending horizontally rearwardly from the underside of the ridge 20 are two diametrically opposed, parallel struts 28 and 30 forming a jaw attachment fork. The struts 28 and 30 contain in registered alignment transverse apertures.

The pinching assembly 32 in the lower compartment 16 embodies three main components, pivotal jaws 34 and 36 for receiving and grasping the flexible tubing through which the intravenous feeding liquid flows, a pinching element 38 slidably and travelably received within the jaws and through which the flexible tubing passes and a rotary shaft assembly 40 for causing the slidable travel of the pinching element.

Jaws 34 and 36 are pivotally journaled on a retaining pin 31 transversing between struts 28 and 30 and firmly engaged in the registered aligned apertures thereof in a manner obvious to one skilled in the art. The jaws can thus pivot between a closed position and an open spread-apart position. Turning now to the cross-sectional views of FIGS. 4 and 5, the jaws include confronting inner faces 42 and 44, which are contiguous in the closed position. Below the pivotal attachment point to pin 31 each of the faces 42 and 44 contains a transverse semicircular notch which have a common center axis when the faces are contiguous and which form through the jaws when closed a circular passageway, the diameter of which is slightly less than that of the diameter of the flexible tubing. The passageway receives and tenaciously holds the flexible tubing. In each of the two faces 42 and 44 there is also a longitudinal groove 50 and 52 extending downwardly from the upper edge thereof to perpendicularly bisect the notches 46 and 48. The grooves are, flared outwardly adjacent the upper edge of the faces and are aligned so as to have communication therebetween when the faces are contiguous and to form a unitary longitudinal rectangular downwardly extending opening in the top of the jaws when closed as shown in FIG. 10.

Locking the jaws in the closed position can be accomplished by a variety of means commonly known in the art, and in the preferred embodiment is done by a stud 60 having one end pivotally attached within a transverse groove 56 at the lower end of jaw 34 and on the opposite end thereof male threads 62. When the jaws are closed, the stud 60 is inserted into a transverse groove 58 in the lower end of jaw 44, the threads 62 projecting outwardly therefrom. A nut 64 having a knurled periphery is threadedly engaged with threads 62 to secure the jaws together.

The pinch element 38 includes two elongated blades, 66 and 68, then in cross section and having inwardly cantilever upper ends containing registered aligned apertures through which an axis pin 72 passes in pivotally attaching the blades to pinch fork 70. Rigidly affixed to and extending vertically upwardly from pinch fork 70 is a thread shaft 74.

The blades are made coplanar and the inner longitudinal edges thereof confronting by the imposition of a proper kick in one of the blades in a manner commonly known in the art. The inner edges of the blades 66 and 68 are symmetrically shaped to cooperate to provide, when the blades are closed, the sides of an upper wide slot 78 and a narrow lower pinch slot 80 in direct communication with each other.

The wide slot 78 has a width slightly greater than the outer diameter of the flexible tubing and the pinch slot 80 has a width substantially equal to two times the wall thickness of the tubing.

Abrupt transition from the wide to pinch slot is attained by having the border edges 82 and 84 therebetween perpendicular to the longitudinal sides of each. Border edge 82 is curved in cross section, the radius being approximately 0.015 inch as shown in the partial cross-sectional view of blade 66 in FIG. 8. The inner corner of the border 82 is also curved, the radius being approximately 0.005 inch as shown in the partial plan view of blade 66 in FIG. 9. Border edge 84, being symmetrical, is identically curved in plan and cross section. The curvature of the border edges 82 and 84 allows the circular form of the tubing 11 to assert itself easier during the pinching operation which will be subsequently discussed.

The blades 66 and 68 are slidably inserted in the grooves 50 and 52, through the top opening thereof and follow the movement of the jaws 34 and 36; that is, the blades pivotally open when the jaws are spread apart and close when the jaws are closed. The slots 78 and 80 are positioned relative to the passageway 76 of the jaws so that tubing received therein passes therethrough.

Turning now to the rotary shaft arrangement 40, for causing the travel of the pinch element 38 and referring specifically to FIG. 4, a screw actuator 90, an elongated vertical cylinder having an internal longitudinal borehole 92 extending upwardly from the lower end thereof and having intermediate the upper and lower end thereof an outwardly extending horizontal flange 94, is rotatably retained in lower compartment 16 of the case 12 between ridges 20 and 22 by means of various annular washers 96 and a retaining plate 98 attached to ridge 22 by screws 100. Washers 96 and retaining plate 98 create a light antirotary frictional load on screw actuator 92. The upper end of the screw actuator 92 projects beyond the retaining plate 98 through an aperture therein and has thereon male threads. The lower end thereof progresses downwardly through opening 26 to enable female threads 102 on the inner diameter of longitudinal borehole 92 to engage the threads of shaft 74. A bushing 104 is squeeze fitted between the lower end of screw actuator 90 and the inner diameter of opening 26.

Sleeved over the upper end of the screw actuator 90 and threadably engaged to the upper end thereof is a screw carrier 106 which has at the lower end an outwardly extending horizontal annular flange in contact with the upper surface of the retaining plate 98. A knob 108 fits over the screw carrier 106 and is locked thereto by a set screw. Rotation of the knob 108 in proper direction causes vertical travel of the pincher element 38 with respect to the jaws 34 and 36 and more particularly with respect to the transverse passageway formed by notches 46 and 48.

The internal manipulation of flexible tubing 11, received in the passageway and passing through slots 78 and 80 during travel of the pinch element 38 is shown in FIGS. 6 and 7. In FIG. 7, the pinch element 38 has been retracted upwardly so that the full width of tubing is transversely by pinch slot 80 and is consequentially pinched shut to prevent liquid flow therethrough. Counterclockwise rotations of screw actuator 92 by knob 108 forces the pinch element downwardly allowing a portion of the tube to expand into wide slot 78. Due to

the specified curvature of border edges 82 and 84, the expanded portion of the tube forms an orifice 116 elliptical at first but becoming circular as the tube itself tends to return to the original circular configuration thereof. The transition from an elliptical shape to a circular one increases the orifice area with a resultant increase of flow rate therethrough. However, this increase is offset by a decrease in head pressure caused by loss of liquid in the dispensing bottle of the administration set and consequentially a substantially constant liquid delivery rate is attained during the entire intravenous feeding period.

Obviously as the pinch portion 80 continually travels downwardly, the orifice 116 progressively expands until full flow is achieved. Conversely continually upward transversement of the pinch portion 80 over the flexible tube 11 results in an orifice of diminishing diameter until no flow occurs.

A scale 110 having logarithmic indicia calibrated in drops of liquid fluid per minute is received over the screw carrier 106 intermediate the case 12 and the knob 108 and is held thereon for frictional rotation therewith by washers 112.

A pointer 114 screwed to the face of the upper compartment 14 of the case 12, projects over the circumference of the scale 110 to facilitate in the reading of the indicia thereon.

Turning now to the upper compartment 14 of the case 12, a stopwatch 24 has internal springs and gears similar the standard stopwatches readily available in the industry. The circular dial 118 of the stopwatch is calibrated around the periphery in drops of liquid flow per minute. A handle 120 projecting forwardly from the stopwatch includes a knob thereon and services to both wind the stopwatch and to return the dial to the zero setting. The dial has at the zero setting point an upwardly extending stud 122 and the case has thereon an inwardly cantilever rod 124 which cooperates to assure proper gearing of the dial. A stopwatch actuator lever 126 extending outwardly from the case as shown in FIG. 3 serves to operably engage and disengage the timing mechanism of the stopwatch. A tube clamp 128 is screwed to the flange 18 of the upper compartment 14.

In operation the flow control knob 108 is turned clockwise as far as possible to bring the pinch element 38 upwardly and cause the pinch slot 80 to intersect the passageway formed by the notches; that is, the apparatus is put in a no-flow position. Next the jaws 34 and 36 and the blades 66 and 68 are spread apart to receive the flexible plastic tubing 11 in notches 46 and 48. The jaws are then closed and locked by stud 62 and the plastic tubing is engaged in tube clamp 128. Thus positioned, the pinch slot 80 pinches the entirety of the tubing and shuts off liquid flow therethrough. The shaft assembly 40 is rotated counterclockwise until liquid flow is established whereupon rotation of the shaft assembly is reversed until flow stops. At this time the control knob 108 is again rotated counterclockwise until a slow drip rate of fluid flow occurs. The nurse or physician, having previously zeroed the dial 118, then energizes the stop switch 24 by depression of actuator 126 and times two consecutive drops. By reading the flow rate in drops per minute directly from the calibration on dial 118 as under rod 124, the nurse by overcoming the light frictional force therebetween positions the identical indicia reading on scale 110 under pointer 114 without rotation of the shaft assembly 40. Scale 110 having been correctly obtained by turning the control knob until zero on scale 110 shows under the pointer and then by reverse rotation of the knob setting the indicia on scale 110 corresponding to the new prescribed rate under the pointer 118.

In describing the preferred embodiment of this invention specific terminology has been used. However, it is to be understood that such was done for the sake of clarity and was not meant to be used by limitation and all terminology used includes all equivalents which operate in a similar manner to accomplish a similar purpose. For instance, the jaws holding the flexible tubing could be substituted with two rectangular solids appropriately clamped together having a groove therebetween to accept the pincher element.

I claim:

1. An apparatus for the controlled intravenous feeding of drops of fluid through flexible circular tubing comprising: juxtaposed tubing receivers for capturing and tenaciously retaining said tubing;
a slidable pinching element interposed between said tubing receivers and having therein an elongated open-ended slot of width less than the outer diameter of said tubing; and
means for causing sliding movement of said pinching element relative to said tubing receivers whereby said tubing is transversed by said open-ended slot and is simultaneously pinched to effectuate therein a substantially circular orifice of adjustable diameter to control the magnitude of flow therethrough.
2. An apparatus as in claim 1 wherein said tubing receivers are composed of jaws pivotal about a common axis and having confronting faces and means for contiguously securing said faces, each of said faces containing a coaxial transverse semicircular notch to cooperatively receive and hold said flexible tubing; each of said notches being intersected by a longitudinal groove extending downwardly in an upper edge of said faces, said grooves being in registered alignment to slidably receive therewithin said pinching element.
3. An apparatus as in claim 2 wherein said jaws are pivotally carried on a case having a concentric aperture therethrough.
4. An apparatus as in claim 3 wherein:
said pinch element comprises:
two symmetrical axially aligned blades pivotal about a common point, one each received in said longitudinal groove in each of said faces of said jaws, said blades having inner edges shaped to cooperate to provide a wide slot and a

- pinch slot in mutual communication, when said jaws are secured together; and
said means for causing vertical movement of said pinch element comprises:
a shaft assembly rotatably journaled through said aperture in said case and having at the lower end thereof an elongated borehole containing female threads;
a stud having one end rigidly affixed to said pinch element adjacent the point of pivotation; the opposite end threadably engaged in said borehole of said shaft; and
means on the upper end of said shaft to facilitate the rotation thereof.
5. An apparatus as in claim 4 wherein said means for facilitating rotation of said shaft comprises a knob affixed to the upper end thereof.
 6. An apparatus as in claim 5 including:
a circular scale concentrically journaled over said shaft assembly intermediate said case and said knob and in frictional contact therewith; said scale having indicia calibrated around the periphery thereof in quantity of liquid flow per time division; and
a pointer secured to said case and extending over said indicia.
 7. An apparatus as in claim 5 including:
a stopwatch affixed to case, said stopwatch having a timing mechanism and a dial calibrated in quantity of flow of fluid per time division;
means thereon for winding said timing mechanism and setting said dial; and
means thereon for engaging and disengaging the timing mechanism thereof.

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