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FLOW REGULATING DEVICE

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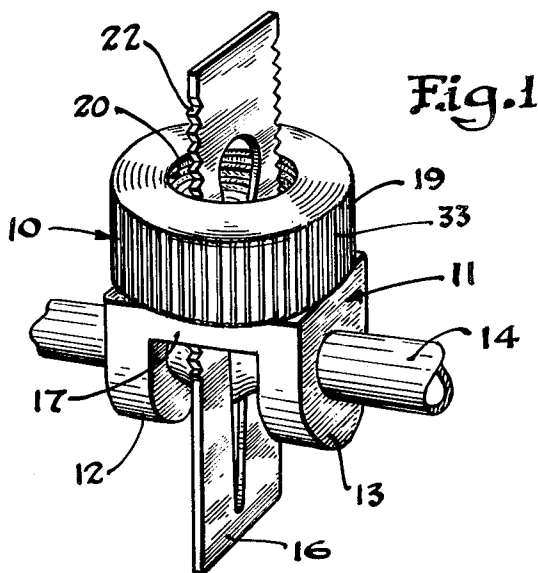


Fig. 1

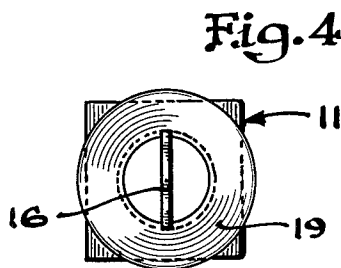


Fig. 4

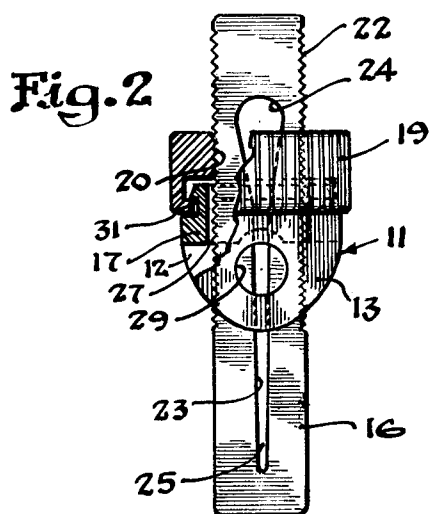


Fig. 2

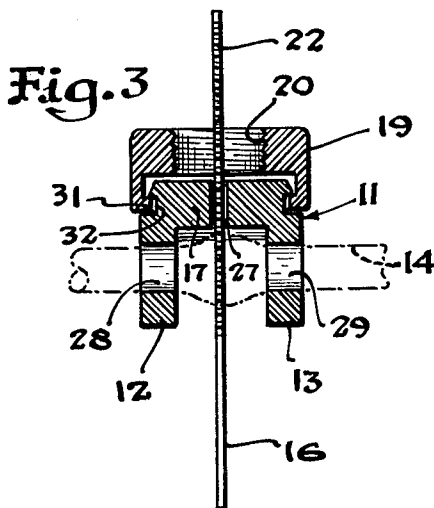


Fig. 3

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## FLOW REGULATING DEVICE

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3 Claims. (Cl. 251-8)

This invention relates to an adjustable tubing clamp for regulating the flow through flexible tubing. More particularly, the present invention relates to an improved tubing clamp which serves to compensate for the undesired "cold flow" properties commonly associated with plastic tubing.

In the administration of parenteral solutions, it is common practice to employ a length of flexible tubing for conveying the solution from a container to the recipient. The flow rate of such solutions is measured in such minute quantities as drops per minute. Some means, therefore, must be provided to accurately regulate the flow of the parenteral solution through the tubing. The preferred flexible tubing used in administering parenteral solutions is composed of a polyvinylchloride plastic material. This particular material is well suited for its purpose because it has the ability to withstand various types of sterilization techniques. It is also relatively inert and contamination is kept to a minimum. One of the serious disadvantages of polyvinylchloride, however is that it tends to "flow" once it is placed under an appreciable stress. This is what is known in the trade as "cold flow." It is a common complaint that when polyvinylchloride tubing is partially pinched to a designated degree so that a precise amount of solution is flowing therethrough, after a very short period of time, the rate of flow will continue to decline. Consequently, the clamp must be continually adjusted in order to maintain a steady rate of administration. The steady decline is attributed to the "cold flow" properties of the polyvinylchloride tubing wherein the tubing tends to constrict itself in such a manner that the passage therein becomes smaller and smaller.

Various types of tubing clamps have been employed in an attempt to constrict flexible tubing in such a manner that the "cold flow" properties of the flexible tubing such as polyvinylchloride is lessened as much as possible.

It is an object of the present invention to provide a tubing clamp for flexible tubing which will precisely regulate the flow of liquid therethrough.

It is also an object of the present invention to provide a tubing clamp which can be minutely adjusted so as to maintain a constant rate of flow through plastic tubing having "cold flow" tendencies.

It is a further object of this invention to provide a flexible tubing clamp which accomplishes the foregoing objects while reducing the amount of "cold flow" of the tubing to a minimum.

The foregoing and other objects of the present invention will be readily appreciated by reference to the following detailed description when considered in conjunction with the accompanying illustrative drawing of a preferred embodiment of the present invention wherein:

FIGURE 1 is a perspective view of the improved clamp operatively engaging and constricting a length of flexible tubing;

FIGURE 2 is a side elevational view, with a portion broken away, of the clamp of FIGURE 1 rotated at approximately 90° and with the flexible tubing removed therefrom;

FIGURE 3 is a view in vertical section of the clamp of FIGURE 1; and

FIGURE 4 is a top plan view of the clamp of FIGURE 1.

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In the illustrative drawing, a flexible tubing clamp designated generally at 10 comprises a substantially U-shaped clamp body 11 having axially extending leg portions 12 and 13 for accommodating a length of flexible plastic tubing 14 therethrough. The tubing 14 is, in this instance, composed of a polyvinylchloride plastic material for better illustrating the constricting mechanism of the tubing clamp 10 and the problems concerned with such tubing. A constricting bar 16, which comprises a thin metal axially extending plate, is movably and axially disposed in a bridge portion 17 of the clamp body 11 between the leg portions 12 and 13 for intersection with the tubing 14. A non-traveling nut 19 is mounted on the bridge portion 17. Internal threads 20 are provided in the nut 19 for threadable reception by an externally threaded portion 22 of the constricting bar 16.

Referring specifically to FIGURE 2, it will be seen that the constricting bar 16 has an internal gradually tapering tubing constricting slot 23 with a substantially V-shaped configuration. The gradually tapering tubing constricting slot 23 has a somewhat semi-circular opening portion 24 at one end and tapers inwardly in the direction opposite the opening to form a more constricted opening portion 25. The semi-circular opening portion 24 is of sufficient dimension to accommodate the tubing 14 without constriction, while the constricted opening portion 25 is of a dimension to completely compress the tubing 14 so that the flow of liquid therethrough is rendered impossible. The gradual taper of the slot 23 between the opening 24 and the constricted portion 25 provides for incremental constriction and consequently incremental selection of the rate of flow of liquid through tubing 14. As best illustrated in FIGURE 3, the constricting bar 16 extends transversely through the bridge portion 17 and is guided therein by an axial guide slot 27. The constricting bar 16 extends from the bridge portion 17 in a parallel manner with respect to the leg portions 12 and 13 and equidistant between them. The tubing 14 is centrally disposed through the clamp body 11 by passageways 28 and 29 of the leg portions 12 and 13, respectively. The constricting bar 16 is centered in the bridge portion 17 of the clamp body 11 in a transverse manner with respect to the tubing 14 so that the tubing 14 when held by the transverse passageways 28 and 29, is aligned for constriction by the slot 23. Reference is made to FIGURE 2 which specifically shows the transverse alignment of the slot 23 with the passageway 29 and the passageway 28.

The non-traveling nut 19 is retained on the clamp body 11 by means of an inwardly projecting flange 31 and a circumferential groove 32 in the clamp body 11, whereby the nut 19 is locked onto the clamp body 11. The nut 19 has a knurled surface 33 for easy grasping. For the same reason, it is designed to extend a short distance beyond the walls of the clamp body 11 between the corners thereof as best shown in FIGURE 4. While the overall configuration of the clamp body 11 is U-shaped, the top is rectangular. The constricting bar 16 is relatively narrow in construction and is disposed within the confines of the circular, non-traveling nut 19. It will be noted that constricting bar 16 is spaced a short distance from both arm portions 12 and 13. The distance from the constricting bar 16 to the arm portions 12 and 13 is approximately 1/8". The total distance between the inner-faces of legs 12 and 13 is approximately 5/16". These dimensions are found to work well with the tubing 14 having an internal diameter of .120" and an outside diameter of .170". Its purpose is to prevent the tubing from constricting itself in the passageways when it is constricted by the slot 23. If the constricting bar 16 were to abut against either of the leg portions 12 or 13 when the tubing 14 is constricted by the slot 23, the stress

which is exerted on the tubing would tend, in turn, to constrict the tubing in the adjacent passageways because of the confinement of the tubing by the walls of the clamp body with the result that the same "cold flow" problem associated with slot 23 and the tubing would occur in the adjacent passageways. Passageways 28 and 29 are of a slightly smaller dimension than the tubing 14 so that a slight frictional resistance occurs. Consequently, the tubing clamp 10 can be moved along the tubing 14 to any pre-selected point and will remain at that point even though no constriction is caused by constricting bar 16.

To operate the tubing clamp 10, the nut 19 is turned to align semi-circular opening 24 in the slot 23 with the passageways 28 and 29. A length of flexible tubing 14 which is part of the common intravenous administration set is passed through the passageways 28 and 29 and consequently through the semi-circular opening portion 24. When it is desired to restrict or stop the flow of liquid through the tubing 14, the non-traveling nut 19 is rotated in a direction to move the more constricted opening portion 25 of the slot 23 toward the bridge portion 17. During the administration of parenteral liquids, the constricting bar 16 will assume the position as shown in FIGURE 1. In other words, the tubing 14 is only partially constricted by the slot 23 and some liquid is allowed to flow through the tubing.

As previously explained, plastic tubing, when placed under stress tends to "flow" and constrict by itself, thereby reducing the flowage through the tubing. To compensate for this self-constriction, the nut 19 can be rotated slightly to move the constricting bar 16 incrementally so that the tubing 14 is positioned in a less constricted portion of the slot 23.

It will thus be apparent that applicant has provided a tubing clamp for flexible plastic tubing having means for precise and accurate adjustment to compensate for the "cold flow" properties of plastic tubing. The adjustment means in carrying out its function also avoids creating further stress, and consequently, additional "cold flow." Even where "cold flow" is not a problem in tubing, the tubing clamp provides for incremental regulation of the flowage rate of the parenteral solution. The present tubing clamp prevents any accidental or unintentional over-constriction or overrelease of the tubing during adjustment.

Constricting bar 16, in this instance, is composed of aluminum, but other non-corrodible metals can be employed. The clamp body 11 and non-traveling nut 19 are composed of polyethylene, however, other semi-rigid and rigid plastic materials such as polypropylene, polyamides, polystyrene, methylmethacrylate, and other acrylate polymers commonly known as Implex, can also be utilized. The semi-rigidity of the clamp body 11 allows the flange 31 of the nut 19 to be snap-fitted into the groove 32 of body section 11.

Others can readily adapt this invention for use under various conditions of service by employing one or more of the features disclosed, or equivalents thereof. As at present advised with respect to the present scope of my invention, I claim the following subject matter.

1. A tubing clamp for regulating flow through a length of flexible tubing, comprising: a clamp body having a pair of axially extending arm portions, a constricting bar mounted in said clamp body for axial movement between said axially extending arm portions, said constricting bar having an axially extending gradually tapering tubing constricting slot, a passageway in each arm portion disposed in general transverse alignment with each other and disposed in general transverse alignment with said gradually tapering tubing constricting slot, said aligned passageways and gradually tapering tubing constricting slot being adapted to receive a length of flexible tubing, said arm portions each being spaced a sufficient distance from said constricting bar to substantially prevent constriction of the tubing in said passageways and means engageable with said clamp body and said constricting bar for actuating said constricting bar axially.

2. A tubing clamp for regulating flow through a length of flexible tubing, comprising: a clamp body having a pair of axially extending arm portions, a constricting bar mounted in said clamp body for axial movement between said axially extending arm portions, said constricting bar having an axially extending gradually tapering tubing constricting slot, a passageway in each arm portion disposed in general transverse alignment with each other and disposed in general transverse alignment with said gradually tapering tubing constricting slot, said aligned passageways and gradually tapering tubing constricting slot being adapted to receive a length of flexible tubing, said arm portions each being spaced a sufficient distance from said constricting bar to substantially prevent constriction of the tubing in said passageways, said constricting bar having a threaded portion, a nut threadably received by said constricting bar, and means for locking said nut against axial movement.

3. A tubing clamp for regulating flow through a length of flexible tubing, comprising: a clamp body having a pair of axially extending arm portions, a constricting bar mounted in said clamp body for axial movement between said axially extending arm portions, said constricting bar having an axially extending gradually tapering tubing constricting slot, a passageway in each arm portion disposed in general transverse alignment with each other and disposed in general transverse alignment with said gradually tapering tubing constricting slot, said aligned passageways and gradually tapering tubing constricting slot being adapted to receive a length of flexible tubing, said constricting bar having a threaded portion, a nut threadably received by said constricting bar, and means for locking said nut against axial movement, said locking means including means for snapping said nut into said clamp body.

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