Dec. 17, 1968 E. K. KAUCHER ET AL 3,416,370

TUBE TYPE FLUID METER AND CONSTRUCTION THEREOF

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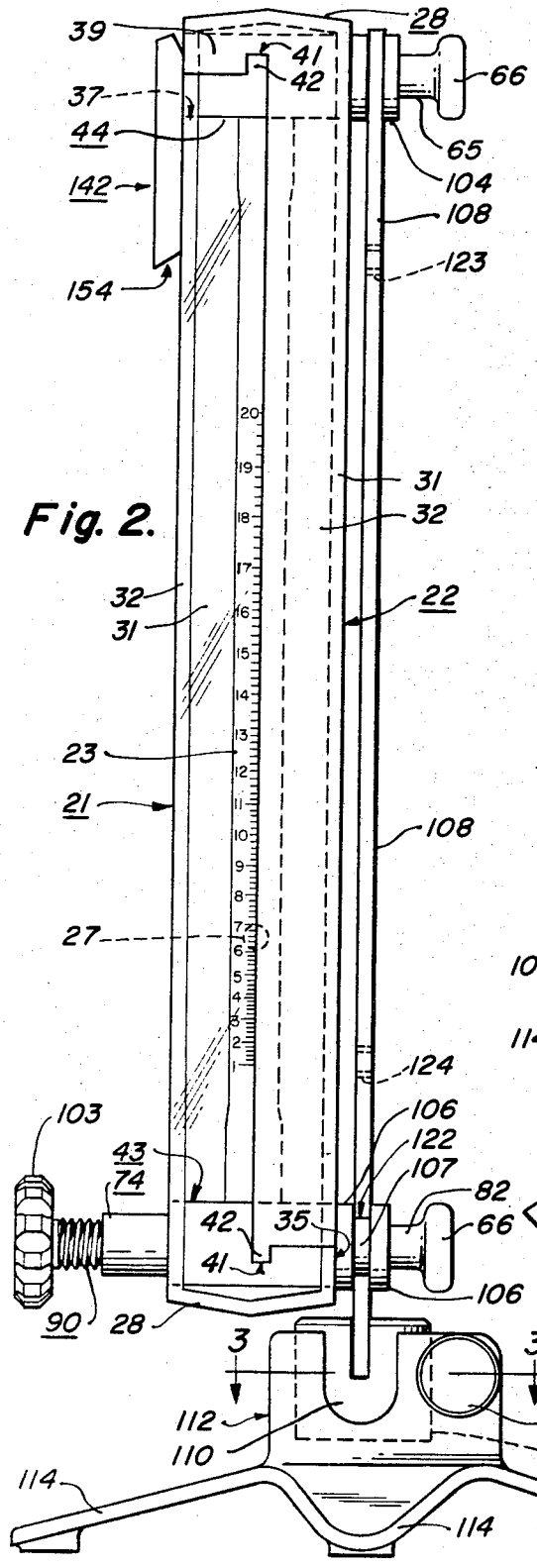

Fig. 2.

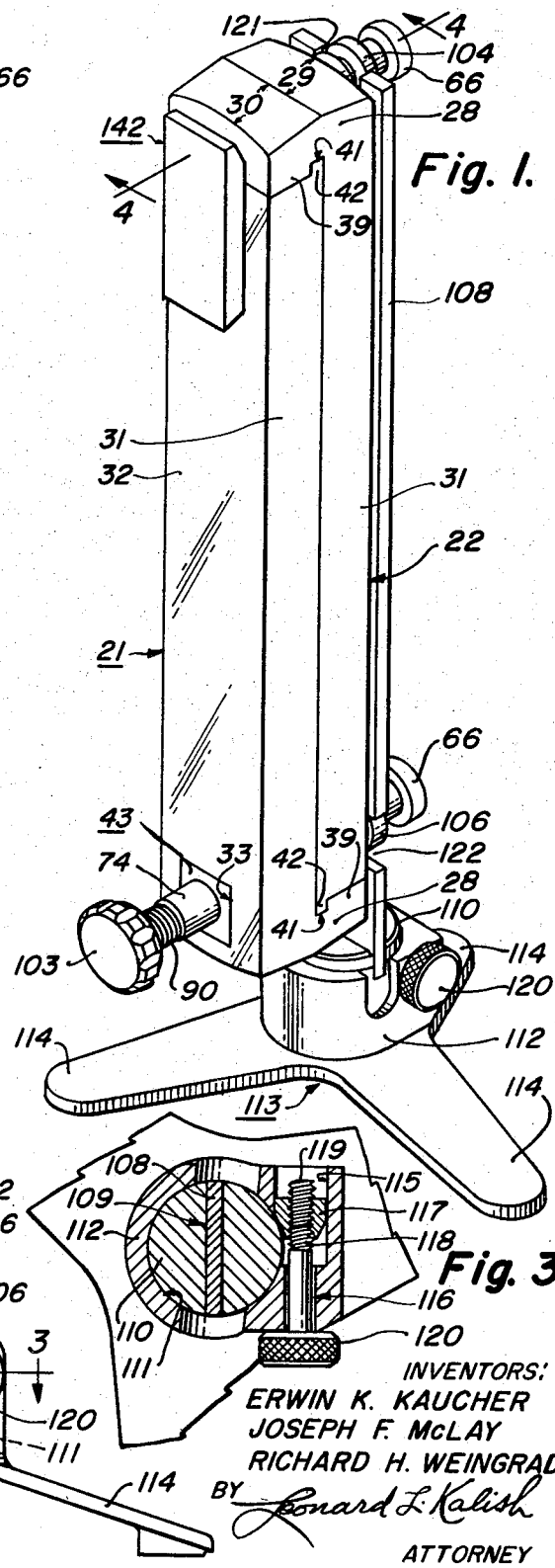

Fig. 1.

Fig. 3.

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TUBE TYPE FLUID METER AND CONSTRUCTION THEREOF

Filed Sept. 15, 1965 7 Sheets-Sheet 2

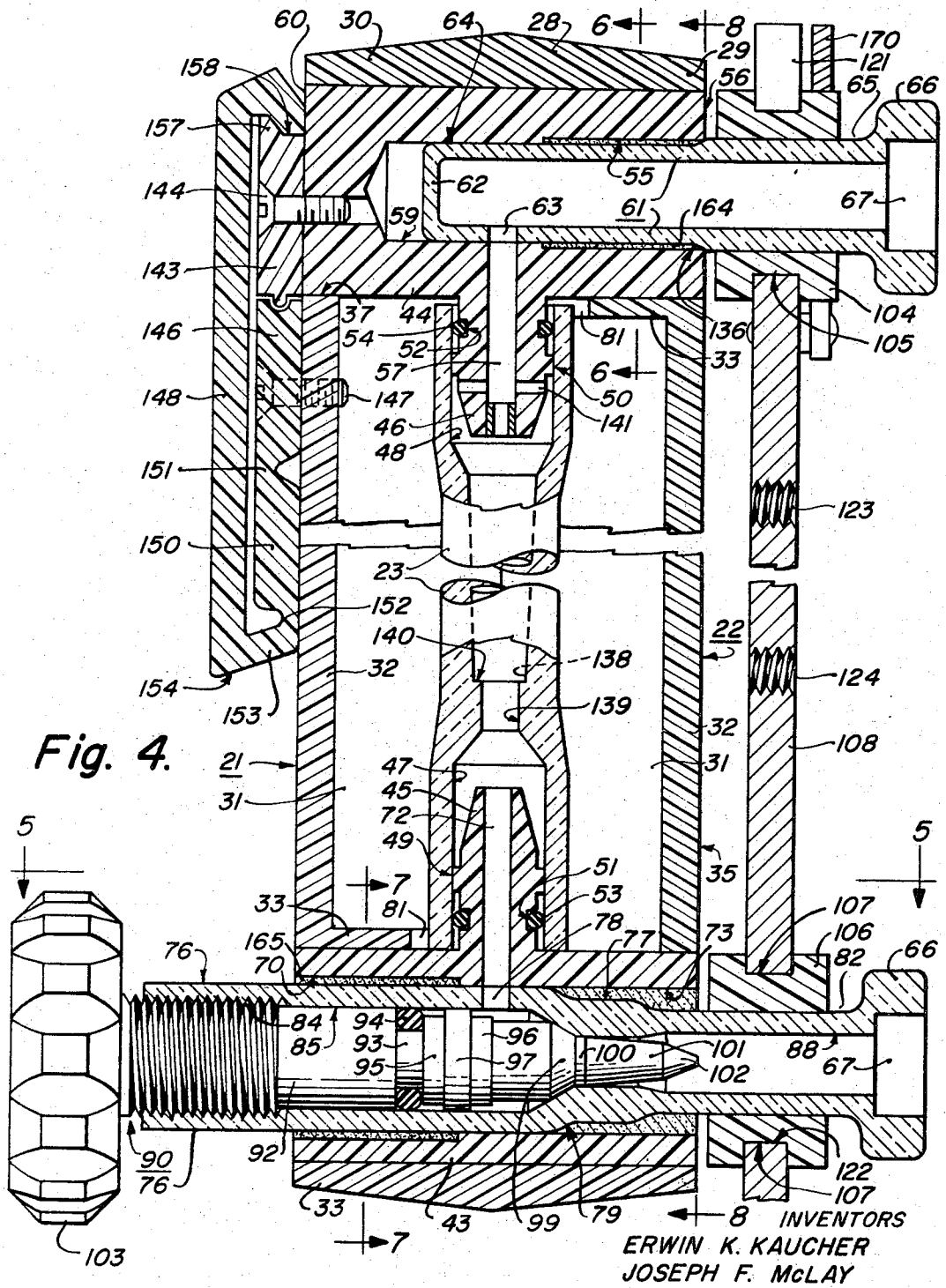

Fig. 4.

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TUBE TYPE FLUID METER AND CONSTRUCTION THEREOF

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Fig. 5.

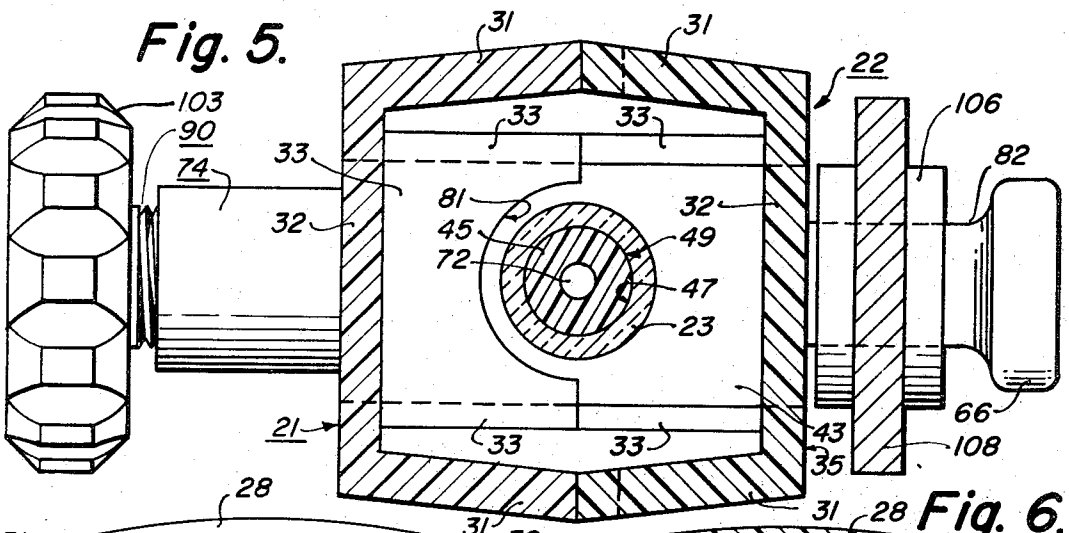


Fig. 6.

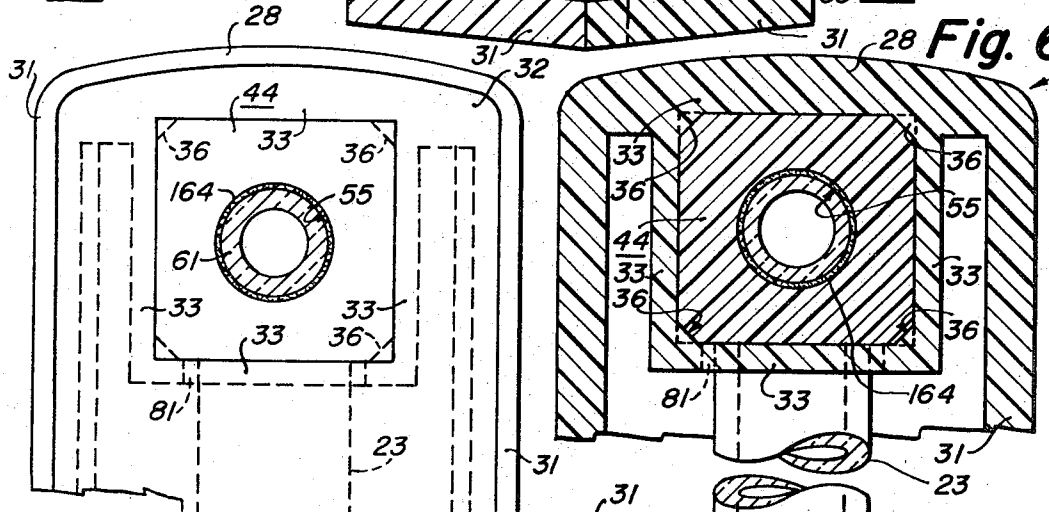


Fig. 7.

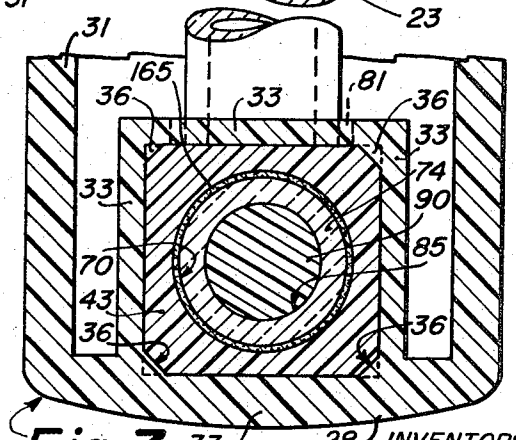
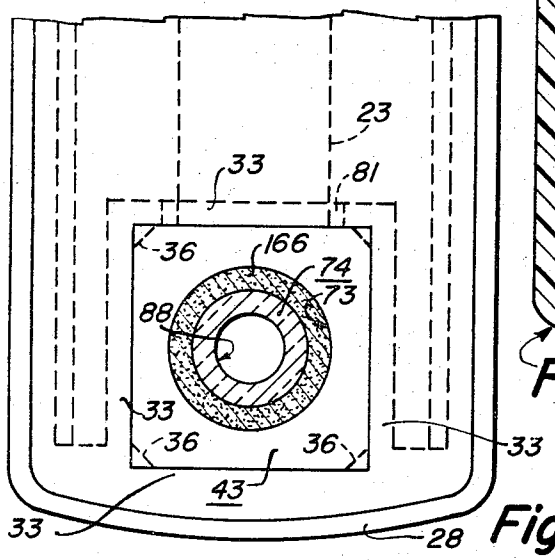


Fig. 8.



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TUBE TYPE FLUID METER AND CONSTRUCTION THEREOF

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Fig. 9.

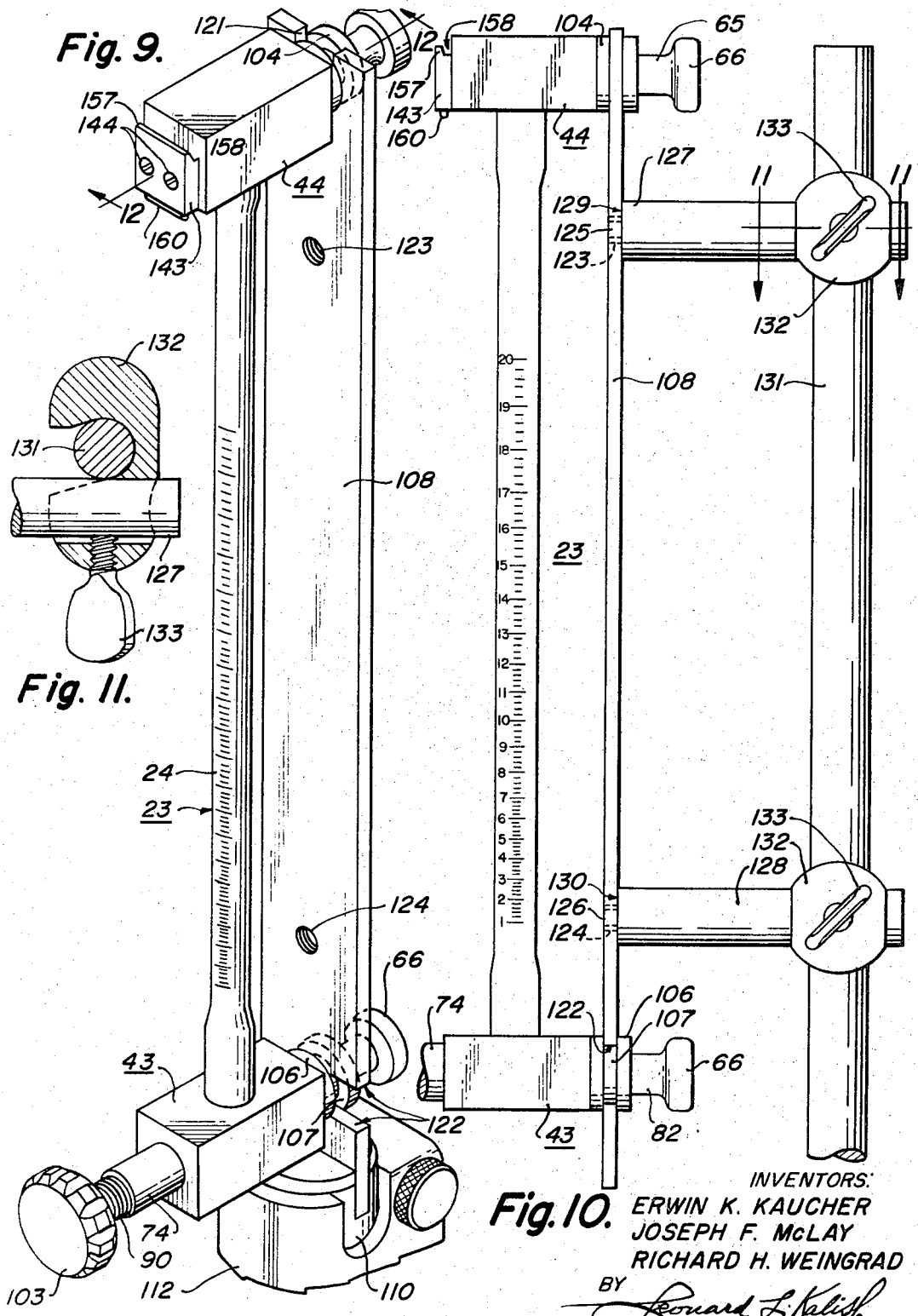

Fig. 11.

Fig. 10.

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TUBE TYPE FLUID METER AND CONSTRUCTION THEREOF

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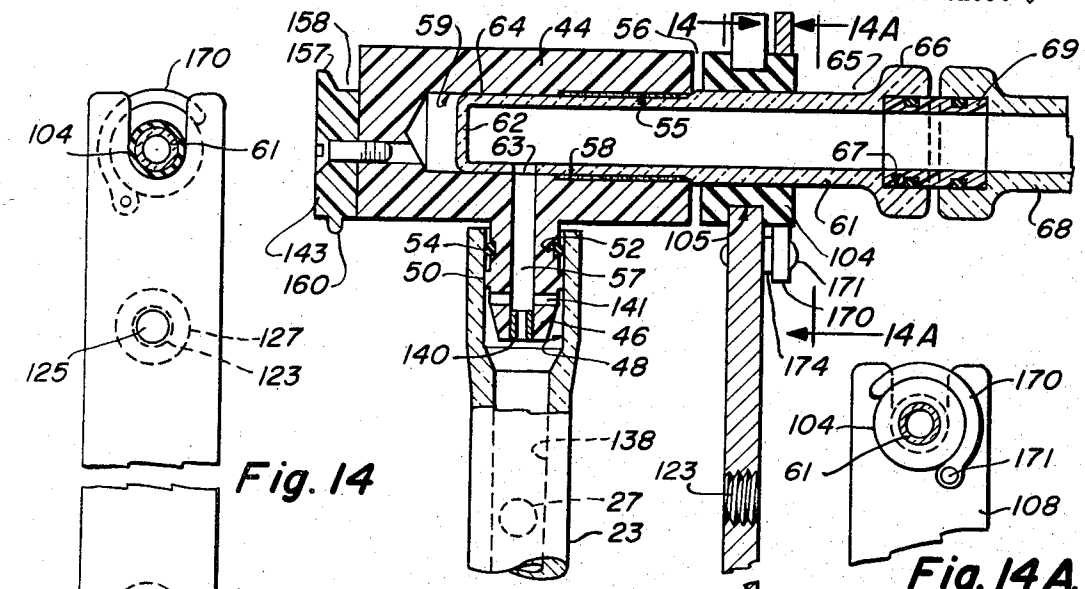
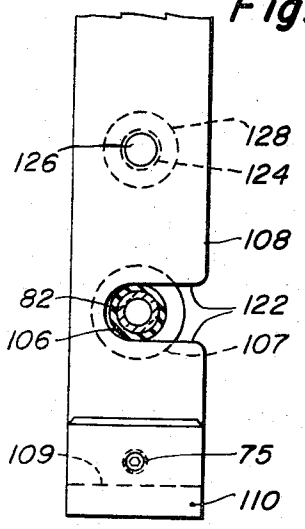


Fig. 14

Fig. 14A.



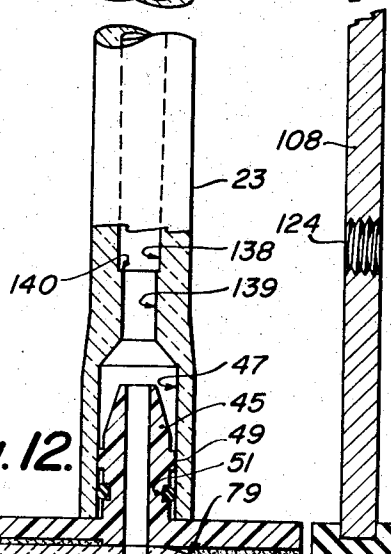


Fig. 12.

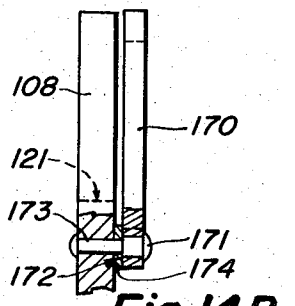
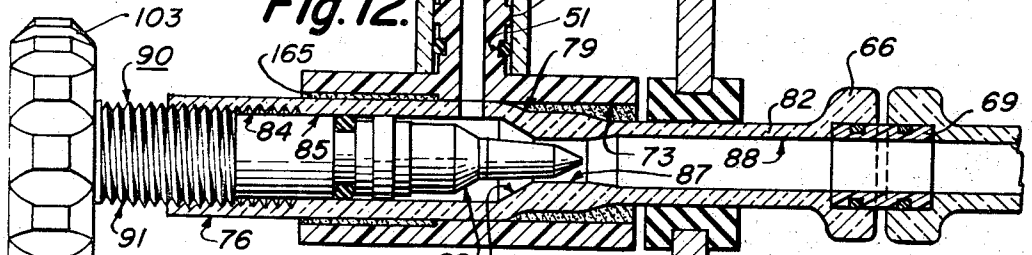


Fig. 14B.



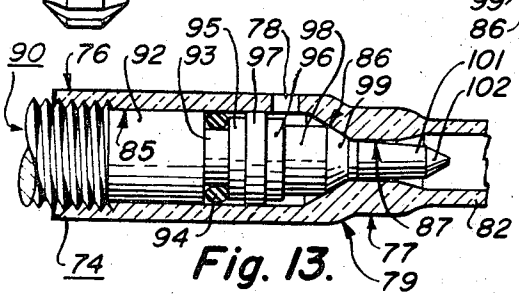
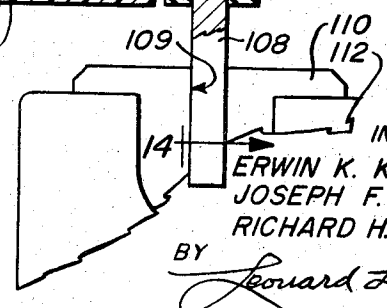


Fig. 13.



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TUBE TYPE FLUID METER AND CONSTRUCTION THEREOF

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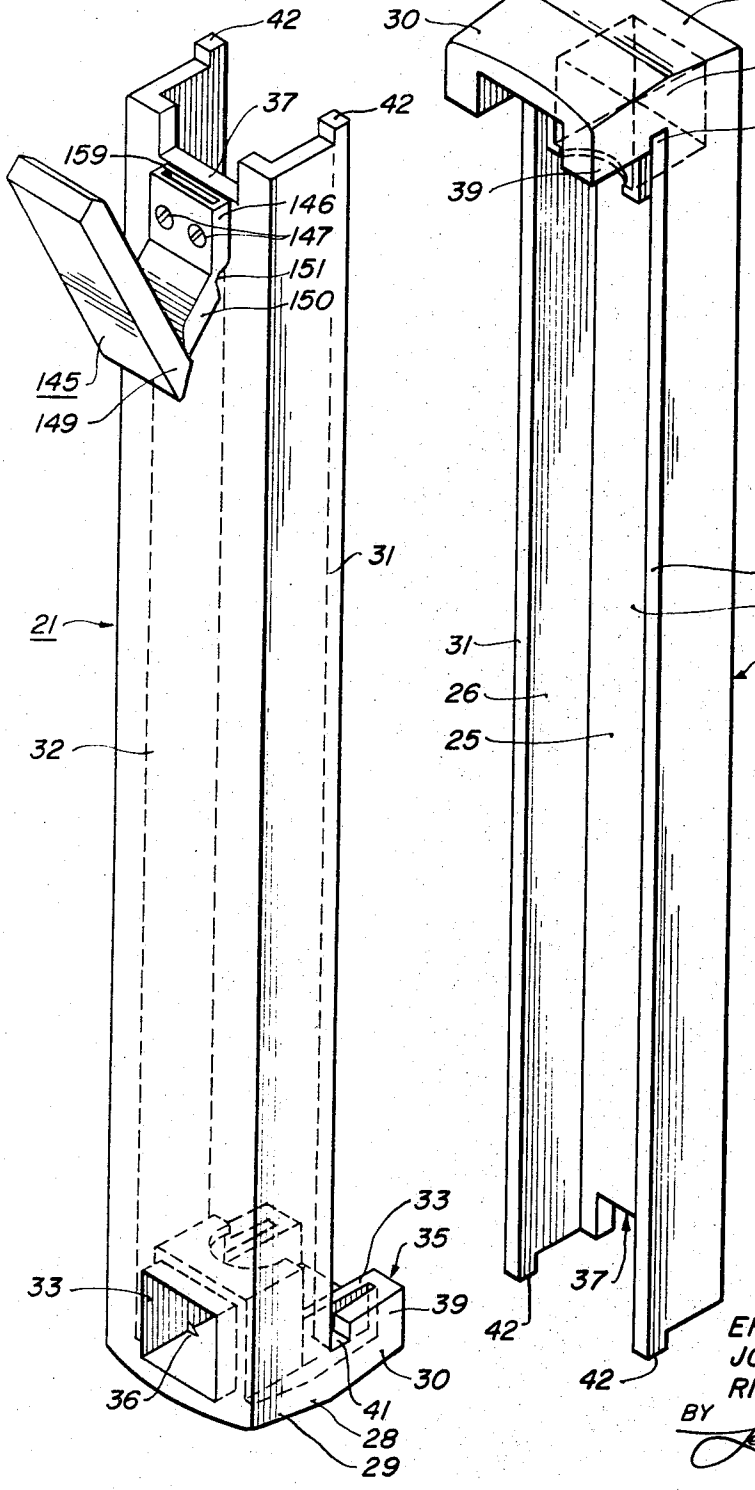
Fig. 15



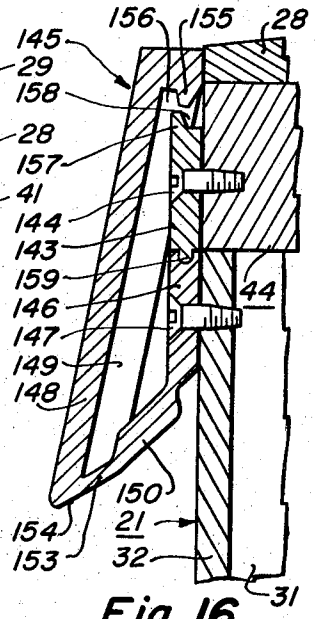


Fig. 16.

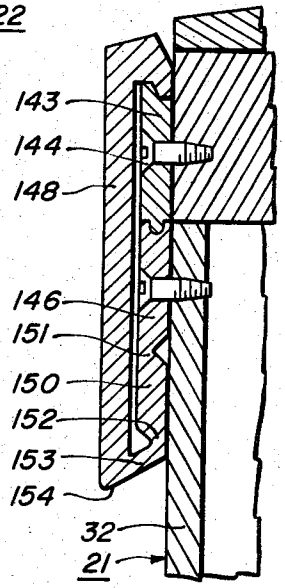


Fig. 17.

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TUBE TYPE FLUID METER AND CONSTRUCTION THEREOF

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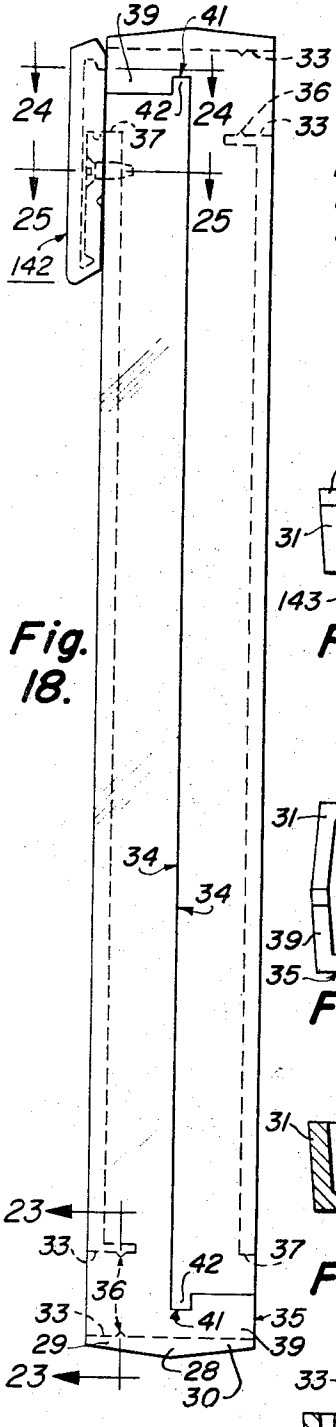

Fig. 18.

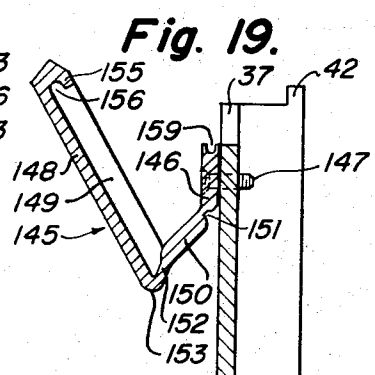

Fig. 19.

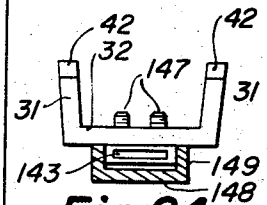

Fig. 24.

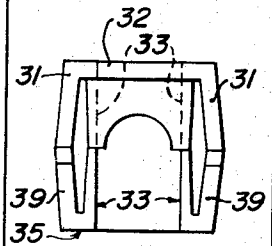

Fig. 21

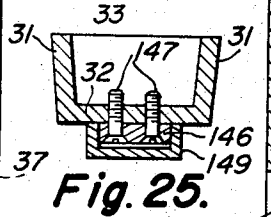

Fig. 25.

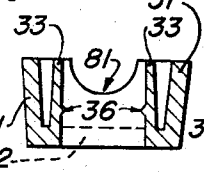

Fig. 22.

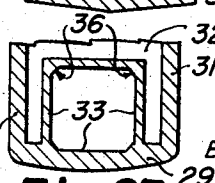

Fig. 23.

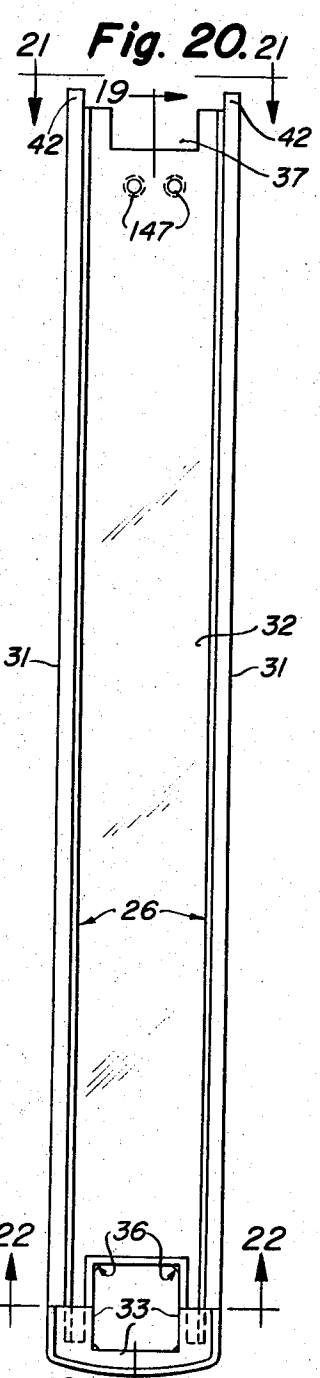

Fig. 20.

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United States Patent Office 3,416,370
Patented Dec. 17, 1968

3,416,370

TUBE TYPE FLUID METER AND CONSTRUCTION THEREOF

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Filed Sept. 15, 1965, Ser. No. 487,355
30 Claims. (Cl. 73—209)

ABSTRACT OF THE DISCLOSURE

A variable-area flowmeter which can be readily disassembled and re-assembled, including two resilient plastic tube-mounting members with integral and co-axial tube-connectors, each having an integral radially-resiliently-comprisible fluid-sealing annulus forming an interference-fit with an end of the metering-tube, an O-ring on each tube-connector between the sealing annulus and the end of the metering-tube, a fluid-line-connecting glass sleeve in each tube-mounting member at a right angle to the axis of the tube-connectors and having its end exteriorly thereof, and a resilient shock-absorber on said exterior ends thereor, and a demountable support detachably interfitting with such shock-absorbers, a flow-throttling valve in one of the glass sleeves, and a two-part hard-plastic housing comprising two similar channel-shaped halves having the edges of their flanges thereof juxtaposed to each other, each channel-shaped housing member being open at one end and closed at the other end by an integral closure portion extending across the juxtaposed open end of the other housing member, interfitting means at the juxtaposed closed and open ends of the two housing members detachably uniting the two against separation from each other in a direction normal to the plane which is common to the edges of the flanges of the two U-cross-sections thereof, and a socket extending through the closed end of each housing member and extending between the flanges and the web at the juxtaposed open end of the other housing member and extending transversely of the housing members, for slidably receiving and operatively mounting the tube-mounting members transversely of the housing members.

The present invention relates to a new and useful flow meter and construction and it relates more particularly to a flow meter of the variable-area type for measuring the rate of flow of liquids and gases.

One of the objects of the present invention is a flow meter of this type, which will be suitable for liquids and gases of a wide range of physical and chemical properties and under widely varying conditions of use and operation. Thus, one of the objects of the present invention is to accommodate liquids and gases of wide range of corrosiveness and solvent powers and at a wide range of temperatures, without materially affecting the operativeness of the flow meter.

Another object of the present invention is a flow meter construction of increased versatility as to variant mountings, installations and uses thereof.

Another object of the present invention is a flow meter construction which permits of the ready disassembly and reassembly of the flow meter and of the various phases and components thereof, as, for instance, the ready removal and insertion of the metering tube and float, and the ready removal or reassembly of the various alternative mountings thereof, and the ready removal and reassembly of the outer casing or housing thereof.

A further object of the present invention is a construction and method which is conducive to a reduction in manufacturing cost while maintaining high quality.

With the above and other objects in view, which will appear more fully from the following description and accompanying drawings, the present invention includes a two-part plastic housing whose two channel-shaped halves are identically shaped, each closed at one end and open at the other, with their like ends disposed at 180° to each other, and upper and lower plastic tube-mountings telescoped thereinto, wherein the two housing members may be made in the same mold, and which housing-members interlock with each other and with the tube-mountings so as to form a self-sustaining assembly of housing-members, tube-mountings and metering-tube.

In another aspect, the present invention includes a construction in which the liquid or gas to be metered does not contact any corrodible or dissolvable or otherwise impairable materials, but contacts only glass and a fluoro-carbon plastic or the like, such as, for instance, Teflon.

Another aspect of the present invention comprises the method of uniting a generally tubular fluoro-carbon tube-mounting member and a glass member telescoped thereinto, so as to form a firm union between the glass and the fluoro-carbon which will reist a mechanical separation and will also form a fluid-tight seal between the contiguous surface of the glass and the fluoro-carbon members.

The present invention also includes other aspects and features of construction and method which will appear more fully from the following description and accompanying drawings.

The accompanying drawings, like reference characters indicate like parts.

FIGURE 1 represents a perspective view of a flow meter constituting an embodiment of the present invention showing the flow-meter and its supporting bracket and table type supporting base.

FIGURE 2 represents a side elevational view of the same.

FIGURE 3 represents a fragmentary horizontal cross-sectional view on line **3—3** of FIGURE 2.

FIGURE 4 represents an enlarged vertical cross-sectional view on line **4—4** of FIGURE 1.

FIGURE 5 represents a horizontal cross-sectional view on line **5—5** of FIGURE 4.

FIGURE 6 represents a vertical cross-sectional view on line **6—6** of FIGURE 4.

FIGURE 7 represents a vertical cross-sectional view on line **7—7** of FIGURE 4.

FIGURE 8 represents a vertical cross-sectional view on line **8—8** of FIGURE 4.

FIGURE 9 represents a perspective view of the flow-meter, but with the outer housing-members removed and the tube-mounting members (and the metering-tube mouned therebetween) operatively supported by the vertical mounting bracket and the table-base.

FIGURE 10 represents a side elevational view of the flow-meter without the outer housing-members (as in FIGURE 9), but with the vertical mounting bracket operatively mounted to a supporting rod of the type commonly used for supporting laboratory glassware and other laboratory apparatus.

FIGURE 11 represents a horizontal cross-sectional view on line **11—11** of FIGURE 10.

FIGURE 12 represents a vertical cross-sectional view on line **12—12** of the FIGURE 9, on an enlarged scale.

FIGURE 13 represents a fragmentary vertical cross-sectional view of the valved glass sleeve (of the lower tube-mounting member) with the valve stem thereof shown in its fully closed position.

FIGURE 14 represents an elevational view of the

notched meter-supporting bracket-plate, viewed on line **14—14** of FIGURE 12.

FIGURE 14A represents a view on line **14A—14A** FIGURE 13.

FIGURE 14B represents a view on line **14B—14B** of FIGURE 13.

FIGURE 15 represents a perspective view of the two identical halves of the housing detached from each other, with only a fastener member attached to the front housing member.

FIGURE 16 represents a fragmentary vertical cross-sectional view, on an enlarged scale, of the upper end of the front housing member and the front end of the upper tube-mounting extending therethrough showing the fastener in its unlatched position.

FIGURE 17 represents a similar fragmentary cross-sectional view, but with the fastener in its latched position.

FIGURE 18 represents a side elevational view of the two-part housing, by itself, namely, with the tube-mountings and metering-tube removed therefrom.

FIGURE 19 represents a fore-and-aft vertical cross-sectional view of the front housing-member, on line **19—19** of FIGURE 20.

FIGURE 20 represents a rear elevational view of the front housing-member.

FIGURE 21 represents a top plan view of the front housing member, viewed on line **21—21** of FIGURE 20.

FIGURE 22 represents a horizontal cross-sectional view on line **22—22** of FIGURE 20.

FIGURE 23 represents a fragmentary vertical cross-sectional view on line **23—23** of FIGURE 18.

FIGURE 24 represents a top plan view of the upper end of the front housing member, viewed on line **24—24** of FIGURE 18, with the fastener shown in cross section (and with the lower end of the housing-member omitted).

FIGURE 25 represents a horizontal cross-sectional view on line **25—25** of FIGURE 18 (but with the lower end of the front housing-member omitted).

The following is a description of the embodiment of the invention as shown in the accompanying drawings.

The front housing member **21** and the rear housing member **22** are identically shaped, and may be molded (preferably injection-molded) in the same mold or die, from a generally chemically inert and impact-resistant hard synthetic resin or "plastic," such as for instance, cellulose-acetate-butyrate exemplified by the synthetic resin marketed under the trademark "Tenite."

The front housing-member **21** is made of a clear transparent form of such plastic, while the rear housing-member **22** is made of an opaque or semi-opaque or translucent form of such plastic which is preferably colored with a selected color according to any chosen color-code indicative of the fluid to be metered or the category or class of fluids to be or being metered. Such selected colors may be imparted to the rear housing-member **22** by suitable pigment or dye incorporated in the plastic material prior to its being molded to form such housing-member. Thus, one color may be selected generally to indicate a gas while another color generally to indicate a liquid. Likewise, a selected color may be used to indicate a liquid of alkaline character while another color may be used to indicate a liquid having an acid character, and still another color may be used to indicate a neutral liquid. Likewise, various colors may be adopted for the rear housing-member **22** to indicate various specific liquids or specific gases, or to indicate various categories or classes thereof, according to a chosen color-code; or specific colors may be selected to indicate particular flow-lines in a chemical process.

Instead of making the rear housing member **22** completely opaque, it may be made translucent (and yet colored), so as to permit the transmission therethrough of some light which will illuminate the metering-tube **23** therein and the scale **24** thereon (or adjacent thereto) and the float **27** therein. If made completely opaque, then the vertical inner back surface **25** of the rear housing member **22** may be made white or otherwise light-reflective, so as to form a good background against which the position of the float **27** in respect to the scale **24** may be conveniently read. A white or other light-reflective liner of suitable thin sheet material may be adhesively secured to the inner surface **25**. The inner side-surfaces **26** may be similarly whitened or rendered light-reflective.

Each of the two housing members **21** and **22** is of channel-shaped cross-section, open at one end, and closed at the other end by means of the cap-like portion **28**. The cap **28** includes a channel-closing half **29** and a projecting half **30**; the latter extending beyond the channel of the housing member itself and overlapping the open end of the channel of the other housing member. The channel-closing portion **29** of the cap-portion **28** is formed integrally with the two side-walls **31** and the intervening center-wall **32** of the channel-shaped housing member, as indicated in FIGURES 2, 4, 6, 15 and 19.

A sleeve-like socket **33**, preferably of square cross-section, is formed integrally with the cap-portion **28** and is disposed normal to the main central wall **32** of the housing member. The inner half of the socket **33** (namely, the half thereof which is nearest the open far end of the frame member) extends to the free vertical edges **34** of the side-walls **31** of the housing member, while the other half of said socket, which is adjacent the terminal cap-wall **28**, extends to the plane **35** in which the outer surface of the center-wall **32** of the juxtaposed housing member lies when the two housing members are operatively assembled to each other in the manner indicated in FIGURES, 1, 15, 18 and 19.

The free or open end of the center-wall **32** of each housing member is recessed as at **37**; the shape of the recess **37** corresponding to the inner half of the socket-opening **33**, so that when the two housing members **21** and **22** are assembled to each other, the recess **37** in the open end of one housing member is in alignment with the corresponding inner surfaces of the socket **33** in the closed end of the other housing member and forms a continuation thereof, as indicated in FIGURES 2, 4, 15 and 18.

Each of the cap-portions **28** has side-walls **39**, whose edges face the juxtaposed free ends of the side-walls **31** of the other housing-member, and which are in the planes of the respective side-walls **31** of the other housing-member.

Each of the side-walls **39** is provided with a notch or recess **41** (as indicated in FIGURES 1, 2, 15, 18, 19 and 20) which are adapted interlockingly to receive corresponding projections or detents **42** extending from the free ends of the side-walls **31** of the other housing-member, so that when the two housing-members are juxtaposed to each other with the edges **34** of the side-walls **31** thereof adjacent to and in contact with each other, but with the free end of each spaced from the capped end of the other a distance slightly greater than the length of the projections **42**, a longitudinal shifting of the two housing-members in relation to each other with the cap-portions **28** thereof moved towards each other, the projections or detents **42** of each housing-member enter the recesses **41** of the opposite housing-member and thereby interlock the two members in relation to each other in a fore-and-aft direction transversely of the main longitudinal dimension of the housing-members.

Each socket **33** receives one of the two tube-mounting members **43** and **44**, whose cross-sections are the same as that of the sockets **33**. If desired, the cross-sections of the sockets **33** and of the tube-mounting members (**43** and **44**) may be of another polygonal shape or any other keying shape which will prevent the rotation of the tube-mounting member within its socket.

The top wall of the lower socket **33** and the bottom

wall of he upper socket **33** is provided with a suitable semicircular recess or notch **81** to clear the corresponding end of the metering-tube **23** with a suitable clearance-gap, as indicated in FIGURES 4, 5, 19, 21 and 22.

The tube-mounting members **43** and **44** are formed of a solvent-resistant and chemically inert form-retaining synthetic resin or "plastic" which is resiliently deformable or yieldable to a small extent and has a capacity for recovering from small temporary deformations thereof after the deforming force is removed but will retain some of the deformation for a longer time if the deforming force persists for a longer time, and which will not seize or "freeze" to a glazed glass surface when pressed thereagainst for a long time but will slide therealong in a self-lubricating relationship therewith and form a good stationary as well as sliding fluid-sealing contact therewith when pressed thereagainst, and which will withstand relative high temperatures (from about 300° F. to about 500° F. or 550° F.) without deterioration and is nonwetting in relation to liquids, and which has a high coefficient of thermal expansion in relation to glass and particularly borosilicate glass. The preferred synthetic-resins or plastics for the polytetrahaloethylene or polytetrafluoroethylene resins or fluoro-carbons exemplified by the polytetrafluoroethylene resins marketed under the trademark "Teflon" and the polytrifluorochloroethylene resins marketed under the trademark "Kel-F." Examples of less preferred synthetic-resins are the polypropylene resins exemplified by the commercially available product marketed under the trademark "Profax," the polyethylene resins exemplified by the commercially available product marketed under the trademark "Marlex," the nylon resins exemplified by the commercially available product marketed under the trademark "Plaskon," the polyvinylchloride resins exemplified by the commercially available product marketed under the trademark "Ultron," and the polystyrene resins exemplified by the commercially available product marketed under the trademark "Styron."

The inlet tube-mounting member **43** is nested in the lower socket **33** with an interference-fit such that it can be slid into and out of said socket with reasonable manual force. The outlet tube-mounting member **44** is similarly nested or telescoped in the upper socket **33**. The small thin-edged triangular gussets or ribs **36** in each (or some) of the corners of the sockets **33** (and formed integrally therewith) act as detents in relation to the corners of the tube-mounting members **43** and **44** telescoped thereinto. As the gussets **36** are of the harder plastic of which the housing-members **21** and **22** are formed, and the tube-mounting members **43** and **44** are formed of a slightly yieldable plastic, the gussets temporarily deform the sharp square corners of the tube-mounting members **43** and **44** as the latter are telescoped into the sockets **33** and such deformed corners gradually recover when the gussets have passed, except that at the points where the gussets or ribs **36** come to rest on the corners of the members **43** and **44** in the final operative position of the members **43** and **44** in the sockets **33**. At these points, the gussets or ribs **36** form corresponding depressions in such corners and so serve to keep the members **43** and **44** in their operative positions, namely, their positions in which the outer end-surfaces of the members (**43** and **44**) lie in the planes of the outer surfaces **35** of the center-walls **32** of the housing-members **21** and **22**, respectively. After the tube-mounting members (**43** and **44**) has been in its socket **33** for some time and is then removed therefrom, upon its subsequent insertion into its socket the gussets or ribs **36** snap into such more or less permanent or durable depressions when the tube-mounting members (**43** or **44**) are telescoped into its operative position in its socket **33**. Thus by reason of the slightly yieldable character of the plastic of which tube-mounting members **43** and **44** are formed, the members **43** and **44** may also be repeatedly pushed out of and pushed back into their respective sockets **33** when it is desired to disassemble and reassemble the members **43** and **44** in relation to the housing-members **21** and **22**, respectively; with the gussets functioning as detents in relation to the members **43** and **44**.

The upper tube-mounting member **44** is inserted into and removed from the upper socket **33** from the front. The lower tube-mounting member **43** is inserted into and removed from the lower socket **33** from the rear, while the valve-stem **90** is removed therefrom. The diameter of the upper rubber mounting-bushing **104** and the diameter of the upper coupling-bell **66** are not greater (and preferably slightly less) than the minimum distance across the inner surfaces of the upper socket **33**, so that such bushing **104** and bell **66** will pass freely through the upper socket **33** when the upper tube-mounting member **44** is operatively telescoped into the upper socket **33** or is removed therefrom.

The tube-mounting members **43** and **44** have respective inlet and outlet nipples or tube-connectors **45** and **46** formed integrally therewith. The tube-connector nipples **45** and **46** are telescoped into the cylindrical inlet and outlet bores **47** and **48** (respectively) of the metering-tube **23** and form fluid-tight connections therewith in the manner indicated hereinbelow.

The metering-tube **23** and the metering-float **27** therein are preferably of the type disclosed in U.S. Patent 2,731,-830 entitled "Rotameter and Metering Tube Therefor" issued on Jan. 24, 1956. The metering-tube and float may also be of the type disclosed in U.S. Patent 2,441,350 entitled "Rotameter and Metering Tube Therefor" issued on May 11, 1948. The metering-tube may also be of other internally tapered forms and the float may likewise be of other suitable forms appropriate for the particular type of metering tube.

The outer diameters of the major portions of the bodies of the inlet and outlet nipples or tube-connectors **45** and **46** are either the same as the inner diameters of the corresponding cylindrical bores **47** and **48** (respectively) of metering-tube **23** or are preferably slightly smaller than the inner diameters of such cylindrical bores **47** and **48**. The nipples or tube-connectors (**45** and **46**) are provided with integral radially sealing annular cylindrical portions **49** and **50** (respectively) which are relatively narrow in an axial direction and have slightly oversized diameters in relation to the respective bores **47** and **48**; each of such integral cylindrical sealing annuli forming a dry (namely, unlubricated) non-seizing and slideable fluid-sealing interference-fit with the corresponding cylindrical terminal bore of the metering-tube. Thus, by way of example, with the cylindrical terminal bores of the metering-tube having inner diameters of 0.250", the integral annular cylindrical sealing portions **49** and **50** would have outer diameters of 0.254" to 0.257" (more or less). For different sizes of terminal bores, the oversize of the sealing annuli (**49** and **50**) would be similarly proportionate.

The facing ends of the nipples or tube-connectors **45** and **46** are preferably tapered or chamfered as indicated in the drawings.

The over-size of the upper annular cylindrical sealing portion **50** is preferably greater than the over-size of the lower annular sealing portion **49**, so that a greater interference-fit is formed between the upper sealing annulus **50** and the corresponding terminal-bore **48** than between the lower sealing annulus **49** to the corresponding terminal-bore **47**, so that if the two tube-mounting members **43** and **44** are drawn apart (to remove the metering-tube **23**) without the below-described valve in the lower-tube-mounting member being shut off while the flow-meter is operatively connected to a fluid-line under pressure, the metering-tube **23** will first separate from the lower tube-mounting nipple **43**, thereby preventing the float **27** from being blown or carried out of the top of the metering-tube. Thereupon (after closing said valve) the lower end of the tube **23** may be moved laterally sufficiently to clear

the inlet nipple 45 and then the tube 23 may be pulled downwardly to separate it from the outlet nipple 46.

Thus, by way of example, with each of the two terminal bores 47 and 48 having an inner diameter of 0.250", the outer diameter of the lower sealing annulus 49 may be 0.254" (more or less) while the outer diameter of the upper sealing annulus 50 may be 0.257" (more or less). With metering-tubes having terminal-bores of other sizes, this differential in over-size would be proportionate.

When resiliently compressed in the terminal bores, the integral fluid-seals (49 and 50) provide relatively high pressure per unit contact-area between the sealing annulus (49 and 50) and the inner surfaces of the terminal bore (47 and 48) of the metering-tube, by reason of their over-size and because they are relatively narrow (in an axial direction) and also because they are flanked by integral body portions of the nipples of a diameter but slightly less than that of the sealing annulus; thereby forming a highly effective and durable non-seizing dry (unlubricated) slidable integral fluid-seal between connector-nipple and metering-tube.

Between the annular cylindrical tube-sealing portions 49 and 50 of the nipples 45 and 46, and the respective main bodies of the tube-mounting members (43 and 44), similar annular ring-receiving grooves 51 and 52 are provided, in which O-rings 53 and 54 are mounted to form secondary seals with the corresponding cylindrical bores 47 and 48 of the metering-tube 23, so that if fluid does pass the primary sealing-annuli 49 and 50, the O-rings 53 and 54 will prevent the passage of the fluid to the free ends of the metering-tube 23.

The O-rings 53 and 54 are formed of a fluoro-carbon elastomer more readily deformable and having quicker elastic recovery than the synthetic resin of which the nipples (and tube-mounting members 43 and 44) are formed: such O-ring elastomer being exemplified by the product commercially available under the trademark "Viton."

Each of the tube-mounting members 43 and 44 has a multi-diametered or stepped cylindrical bore therein, in which the respective tubular boro-silicate glass sleeves 74 and 61 are mounted.

The cylindrical bore in the upper tube-mounting member 44 has a larger diametered bore-portion 55 extending inwardly from the rear end 56 thereof to a point 58 somewhat short of the vertical outlet-passageway 57 which extends through the outlet-nipple 46 thereof and into the horizontal sleeve-receiving bore-portion 59. Inwardly of the point 58, a smaller-diametered bore-portion 59 is provided, which extends forwardly to a point past the vertical outlet-passageway 57 but does not extend through the front end 60 of the tube-mounting member being closed as indicated in FIGURES 4 and 12.

The boro-silicate glass outlet-sleeve 61, telescoped into the bore of the tube-mounting member 44, is closed at its front end 62 and is provided with a radial outlet-opening 63 in registration with the vertical outlet-passageway 57 in the outlet-nipple 46.

The portion 65 of the glass sleeve 61 which is outside the tube-mounting member 44 is preferably of a slightly larger diameter than the telescoped portion thereof, as indicated in FIGURES 4 and 12, and a coupling bell 66 may be provided at the rear end thereof, with a sleeve-receiving chamber 67 therein, for the reception of a fluid-sealing coupling-sleeve 69 to form a fluid-tight joint with the glass pipe 68 (having a similar coupling-bell) in accordance with the joint-construction forming the subject matter of co-pending application Ser. No. 47,703 filed May 21, 1965.

The inlet tube-mounting member 43 has a stepped bore extending therethrough, with the larger diametered bore-portion 70 thereof being at the front and terminating at a shoulder 71 which is a suitable distance forwardly of the inlet-passageway 72 in the inlet-nipple 45, as indicated in FIGURES 4 and 12. The smaller-diametered cylindrical bore-portion 73 of the tube-mounting member 43 extends from the shoulder 71 to the rear end of the member 43.

The boro-silicate glass sleeve 74 is nested in the bore of the tube-mounting member 43 and has a larger-diametered cylindrical front portion 76 which extends rearwardly past the inlet-hole 78, to the tapered surface 79, and the smaller-diametered cylindrical portion 77 extending rearwardly thereof, and the still smaller-diametered portion 82 which extends rearwardly of the portion 77 to a suitable distance beyond the rear end of the tube-mounting member 43 as shown in FIGURES 4, 12 and 13. The inlet hole 78 extends through the wall of the glass sleeve 74 in registration with the inlet passageway 72 of the nipple 45 at a point slightly rearwardly of the shoulder 75 and slightly forwardly of the rear end 79 of the largest diametered portion 76 of the glass sleeve 74.

Layers of adhesive or bonding material, designated by the numerals 164, 165 and 166, are interposed in the clearances between the bore-surfaces of the tube-mounting members 44 and 43 and the outer cylindrical surfaces of the glass sleeves mounted therein, for adhesively bonding the glass sleeves and said bore-surfaces, as shown in FIGURE A.

The rear end of the portion 82 of the lower glass sleeve 74 terminates in a coupling-bell 66 similar to and for the same purpose as the coupling-bell of the glass sleeve 61 described hereinabove.

The frontmost bore-portion 84 of the glass sleeve 74 is internally screw-threaded, as indicated in FIGURES 4, 12 and 13. Rearwardly of the threaded bore-portion 84, the bore of the glass sleeve 74 is cylindrical as indicated at 85; this cylindrical portion 85 extending slightly beyond the inlet-hole 78, to the conical bore-portion 86. Rearwardly of the conical bore-portion 86, a short cylindrical bore-portion 87 is provided. Rearwardly of the cylindrical bore-portion 87, the bore tapers or flares outwardly, slightly, to the rear-most cylindrical bore-portion 88 which extends to the coupling chamber 67 of the coupling-bell 66.

A valve-stem, designated generally by the numeral 90, is formed of the same synthetic-resin as that of which tube-mounting member 43 is formed or is formed of other suitable chemically inert and solvent-resistant fluoro-carbon or other synthetic resin having the special characteristics and properties of the synthetic resin of the tube-mounting members 43 and 44 mentioned hereinabove.

The front portion 91 of the valve-stem is externally screw-threaded to match and thread into the internal thread 84 of the glass sleeve 74 with a close running fit. Rearwardly of the threaded portion 91 thereof the valve-stem 90 has cylindrical portions 92, 95 and 96, each of a diameter providing a very slight clearance or an easy-running bearing-fit with the cylindrical bore 85 of the glass sleeve 74. Between the cylindrical portions 92 and 95 thereof, the valve-stem 90 is provided with a ring-receiving groove 93 in which a "Viton" O-ring 94 is operatively mounted to form a fluid-tight seal between the valve-stem 90 and the cylindrical bore-portion 85 of the glass sleeve 74. Rearwardly of the ring-receiving groove 93 thereof, namely, between the aforementioned cylindrical portions 95 and 96 thereof, the valve-stem 90 has an oversized integral annular cylindrical fluid-sealing portion 97, forming an interference-fit with the cylindrical bore-portion 85 of the glass sleeve or valve-housing 74 so as to form a primary fluid-seal between the valve-stem 90 and the cylindrical bore-portion 85.

Thus, by way of example, with the bore-portion 85 of the glass sleeve or valve-housing 74 having an inner diameter of 0.316", the outer diameter of the integral sealing annulus 97 would be 0.320" to 0.321" (more or less). If the bore-portion 85 is of a different diameter, then the over-size of the sealing annulus 97 would be correspondingly proportioned.

A highly effective and durable integral non-seizing, slidable, dry (unlubricated) fluid seal is formed between the sealing annulus **97** and the bore-portion **85** by reason of the resilient compression of the sealing annulus **97** within the bore **85** (due to the over-size of the sealing annulus **97**) and the resultant outward radial pressure exerted by the sealing annulus **97** due to its tendency to restore itself to its original diameter, and because the sealing annulus (**97**) is relatively narrow in an axial direction and beceause it is flanked by integral body portions **95** and **96** whose outer diameter is but slightly less than the outer diameter of the sealing annulus **97**, whereby a relatively high pressure per unit of contact-area is exerted by its sealing annulus **97** against the inner surface of the glass bore-portion **85**.

For convenience in graphically illustrating the aforementioned difference between the outer diameters of the cylindrical portions **95** and **96**, on the other hand (and the relationship of said outer diameters to the inner diameter of the bore-portion **85**), the cylindrical portions **95** and **96** are shown in FIGURES 4, 12 and 13 as being smaller (in relation to the bore-portion **85**) than they actually are, so as to provide visual contrast between the originally over-sized (and resiliently compressed) sealing annulus **97**, on the one hand, and the slightly smaller-diametered portions **95** and **96**, on the other hand.

Rearwardly of the cylindrical portion **96** thereof, the valve-stem **90** has a further reduced cylindrical portion **98**, and rearwardly of the latter it has a conical portion **99**. Rearwardly of the conical portion **99** is a cylindrical portion **100** of a short axial extent and of the diameter which will provide a slight clearance with the frontmost portion of the cylindrical bore-portion **87** or will make an easy running fit therewith.

The conical portion **99** of the valve-stem **90** serves as a shut-off valve member by seating against the like conical bore-portion **86** when the valve-stem **90** is moved to its rearmost or "closed" position.

The valve-stem **90** has a slightly tapered throttling portion **101** at the inner or rear end thereof, which terminates in a conical tip portion **102**. The tapered portion **101** serves as a fine-adjustment throttling means, so as to permit the variation of the rate-of-flow by small increments, by the turning of the valve-stem. The variable positioning of the tapered portion **101** within the cylindrical bore-portion **87** finely varies the annular clearance between the taper **101** and such cylindrical bore-portion **87** and thus finely varies the "valve-opening" to obtain any desired rate of flow. The angle or rate of the taper **101** and the pitch of the screw-thread **89** and **91** are so selected (in relation to each other) that with a suitable number of turns of the valve-stem **90** (as for instance, nine turns), the valve-stem is moved from its fully closed position (indicated in FIGURES 4 and 13) to its fully opened position in which the course-adjustment conical-tip **102** is just withdrawn from the discharge "mouth" of the cylindrical bore-portion **87**. A suitable notched or knurled round handle or knob **103** is suitably secured to the outer end of the valve-stem **90**, whereby the valve-stem may be conveniently rotated for obtaining the desired valve-setting and the corresponding rate of flow.

A rubber, synthetic rubber or other suitable elastic bushing or sleeve **104**, having an annular bracket-receiving groove **105** therein, is mounted on the rearwardly extending outer portion **65** of the glass sleeve **61**, with a sufficiently great resistance-fit so that it will not readily slide along the glass sleeve but may be moved therealong by applying to it sufficient force. The rubber bushing **104** is preferably slipped over the closed front end of the glass sleeve **61** before the latter is telescoped into the bore of the tube-mounting member **44**. A similar rubber or other elastic bushing or sleeve **106**, having a similar annular bracket-receiving groove **107**, is mounted on the rearwardly extending outer portion **82** of the glass sleeve **74**, before the latter is telescoped into the tube-mounting member **43**. In this case the bushing **106** is stretched over either the front end or the rear end of the lower glass sleeve **74**; whichever end has the lesser diameter.

The meter-mounting bracket or plate **108** (FIGURE 14) has its lower end nested and detachably secured in a slot **109** formed in the top of the cylindrical mounting plug **110**, by means of the Allen type set-screw **75** or by any other suitable fastening means which will not interfere with the turning of the mounting-plug **110** in the socket-bore **111**. The mounting-plug **110** is removably nested within the vertical cylindrical socket-bore **111** of the socket member **112** formed at the top of and integrally with the table-supported base **113**. The base **113** is formed either as an upwardly dished circular (or otherwise shaped) plate or is formed with the three legs **114**, as indicated in FIGURES 1 and 2. A horizontal cylindrical chamber or bore **115** is provided in the socket member **112**, intersecting the cylindrical socket-bore **111** thereof (in the manner indicated in FIGURE 3), and a smaller-diametered screw-hole **116** extends from the inner end of the cylindrical chamber **115** to the other side of the socket member **112**. A cylindrical wedging member **117**, having a conical wedging portion **118**, is operatively mounted within the cylindrical bore or chamber **115**. A screw **119** is threaded into the threaded axial hole extending through the wedging member **117**, with its headed stem extending through the hole **116**. By turning the knurled knob or head **120** of the screw **119**, the wedging member **117** may be drawn further into the chamber **115** so that its conical wedging surface **118** will wedgingly bear against the cylindrical outer surface of the mounting plug **110**, thereby to lock the latter within the socket-bore **111** in any desired angular position about its vertical axis and thereby to place the plane of the mounting-bracket or plate **108** in any position within the 360° turning range thereof about its vertical axis.

The meter-mounting bracket-plate **108** is provided with a vertically extending upper recess or notch **121** through its upper end and with a horizontally extending lower recess or notch **122** extending inwardly from one of its two vertical side-edges, as indicated in FIGURES 1, 2, 4, 9, 10 and 14. The width of these notches is generally equal to or very slightly less than the diameter of the corresponding annular groove (**105** and **107**) of the rubber mounting bushing (**104** and **106**), and the thickness of the plate **108** (at least adjacent to said notches) is equal to or slightly greater than the width of such corresponding groove (**105** and **107**), so that when the notched portions of the plate **108** and the corresponding bushings are interfitted with each other, with the notched portions of the plate entering the corresponding grooves of the bushings, the bushings will form a substantial resistance-fit with the plate, so as to resist dislodgement of the plate and the bushings with respect to each other; to an extent sufficient operatively to support the flow-meter in the manner shown in FIGURES 1, 2, 4, 9, 10 and 12.

The flow-meter may be operatively mounted to the plate **108** with the outer housing members **21** and **22** as indicated in FIGURES 1, 2, 4 and 5, or may be operatively mounted to the plate **108** without the outer housing members **21** and **22** as indicated in FIGURES 9, 10 and 12. To mount the flow-meter to the plate **108** (in either case), the upper notched end of the plate **108** is first slid onto the upper bushing **104** with the notch-adjacent portions of the plate entering and nesting within the groove **105**; while holding the plate **108** at a slight angle to the metering-tube **24** so that the lower end thereof clears the lower bushing **106**. By so nesting the upper bushing **104** in the upper notch **121**, the lower horizontal notch **122** is brought into horizontal alignment with the lower bushing **106**. By then moving the lower end of the plate **108** and the bushing **106** towards each other, the lower bushing

106 is similarly nested within the lower notch 122 of the plate, in the manner indicated in FIGURES 1, 2, 4, 5, 9, 10, 12 and 14. The disengagement of the plate 108 from the bushings 104 and 106 is accomplished by first laterally disengaging the lower bushing 106 from the lower notched end of the plate, and thereafter vertically disengaging the upper bushing 104 from the upper notched end of the plate 108.

The flow-meter may be used without the housing-members 21 and 22 (as indicated in FIGURES 9, 10 and 12) when the fluid-pressure in the metered line is either a negative pressure (i.e. some vacuum) or is such a low positive pressure as will not overcome the interference-fit between the cylindrical terminal bore-portions 47 and 48 of the metering-tube 23 and nipples 45 and 46 and which will hence not separate the tube 23 from the tube-mounting members 43 and 44.

The meter-mounting bracket-plate is provided with a pair of suitably spaced threaded holes 123 and 124, into which the smaller threaded ends 125 and 126 of the horizontal rods 127 and 128 may be threaded. The shoulders intermediate the smaller threaded ends of the rods 127 and 128 and the main body portions thereof permits the screw-tightening of the horizontal rods 127 and 128 firmly against the rear surface of the bracket-plate 108, in the manner indicated in FIGURE 10. The horizontal rods 127 and 128 may be detachably secured (in varying positions) upon the conventional laboratory rack-rods, as for instance, the rod 131, by means of clamps 132, having set-screw 133 (as indicated in FIGURE 10). Such rod supporting of the meter-mounting plate 108 is also intended to be used when the housing-members 21 and 22 are operatively mounted to the tube-mounting members 43 and 44; though such rod-supporting of the complete flow-meter (including the housing-members 21 and 22) is not shown in the drawings.

When the meter-mounting plate 108 (and the complete or the housing-free meter mounted thereto) is to be supported by the rods indicated in FIGURES 9 and 11, the mounting-plug 110 may be detached from the plate 108 by loosening the set-screw 75 (or other fastening means) which detachably secures the lower end of the plate 108 to the plug 110.

Below the lower end of the tapered bore 138, of the metering tube 23, a slightly restricted bore-portion 139 is provided, with an intervening shoulder 140, which serves as a lower stop or "rest" for the float 27, thereby making it unnecessary to have a separate float-stop as is customary in flow-meters of the variable-area type.

The same tube-mounting members 43 and 44 and the same nipples 45 and 46 thereof, are adapted to receive and operatively mount different sizes of metering-tube 23, namely having different sizes of tapered bores 138 but having the same nipple-receiving terminal bore-portions 47 and 48. The float 27 matches the size of the taper 138 of the metering-tube 23, with the outermost diameter of the float generally equal to or but slightly less than the smallest diametral cross-dimension or float-guiding dimension of the tapered bore-portion of the tube at the bottom thereof.

In order both to prevent any valving effect by the float 27 coming to rest against the end of the upper nipple 46 (when the flow-rate exceeds that for which the tube and float are designed) and to prevent the float passing upwardly through the outlet passageway 57 (when using a small-bore metering-tube and a correspondingly small float) when the flow-rate exceeds that of the tube-and-float, a synthetic resin plastic sleeve 140 having a bore smaller than the smallest float to be used, is press-fitted into (or otherwise secured in) the lower end of the outlet passageway 57, and a pair of radial (or lateral) outlet holes 141 are provided in communication with the outlet passageway 57; the combined cross-sectional areas of such outlets being in excess of what is necessary to permit the unrestricted flow of the fluid at the maximum rate of flow for which the largest-bore metering-tube and float may be designed. By this means the heretofore conventional separate upper float-stop is eliminated.

A fastener, designated generally by the numeral 142, is operatively interposed between the front end 60 of the upper tube-mounting member 44 and the upper end of the front wall 32 of the front housing-member 21, as indicated in FIGURES 1, 2, 4, 15–16 and 18–19. The fastener 142 serves to interlock the two housing-members 21 and 22 against longitudinal separation from each other in the direction of the axis of the metering-tube 23.

The fastener 142 includes a "keeper" 143 secured to the exposed front end-wall 60 of the upper tube-mounting member 44, by means of screws 144, and the articulated latching member 145 whose stationary end 146 is secured to top of the center-wall 32 of the front housing member 21 by means of the screws 147.

The fastener 142, or at least the latching member 145 thereof, is formed of a generally form-retaining synthetic resin (or "plastic") having sufficient flexibility and resiliency to permit the repeated bending of a narrowed or thinned portion thereof without breakage or fatigue so that such thinned portion may serve as an integral hinge portion or member. Examples of such plastics or synthetic resins are the polypropylene resins exemplified by the product commercially available under the trademark "Profax," and polyethylene resins exemplified by the product commercially available under the trademark "Marlex," and nylon resins exemplified by the product commercially available under the trademark "Plascon," and polystyrene resins exemplified by the product commercially available under the trademark "Styron."

The latching member 145 includes the front hooking portion 148 having integral side-portions 149 which stiffen it and between which the keeper 143 and the stationary end portion 146 and the intervening toggle-portion 150 nest when the fastener is in its latching position indicated in FIGURES 1, 4, 17, 18, 24 and 25.

Intervening the stationary end-portion 146 and the toggle-portion 150 (of the latching member 145) a thinned hinge-portion 151 is provided, and between the toggle-portion 150 and the lower end-wall 153 of the hooking portion 148 a thinned hinge-portion 152 is provided. The two thinned hinge-portions 151 and 152 are offset with respect to each other; the upper hinge-portion 151 being on the outside and the lower hinge-portion 152 being on the inside. The bottom wall 153 of the hooking portion 148 is a rigid part thereof because its lateral ends are integral with the stiffening side-walls 149 of the hooking portion. Therefore, an upward pull of the hooking portion 148 (when in its latched position shown in FIGURE 17) will cause the toggle-portion 150 to be biased (about the hinge-portion 151) towards the center-wall 32 of the front housing-member 21, thereby keeping the fastener in its closed or latched position shown in FIGURES 17, 1, 2, 4 and 18. To unlatch the fastener 142, it is only necessary to exert slight finger-pressure, in an outward direction, against the bottom surface 154 of the hooking-portion member 148, whereby the aforementioned biasing of the toggle-portion 150 is overcome and the unlatching shown in FIGURE 16 is effected; permitting the subsequent outward swinging of the hooking-portion into the position thereof shown in FIGURES 15 and 19.

The upper end of the hooking-portion 148 is provided with a downwardly-facing hook 155 whose lateral ends are integral with the side-walls 149 thereof, and a recess or groove 156 is provided between the hook 155 and the front wall of the hooking-portion 148. The keeper 143 is provide with an upwardly facing detent 157 along its upper front edge and with a clearance 158 therebehind. The hook 155 enters the clearance 158 and the detent 157 enters the recess or groove 156 when the fastener is in its latched position shown in FIGURES 17, 18, 1, 2 and 4.

The upper edge of the stationary portion **146** of the latching-member **145** is provided with a recess or groove **159** shown in FIGURE 15, which is adapted to receive the downwardly-facing tongue **160** of the keeper **143** when the fastener **142** is in its latched position; the tongue **160** then nesting in the recess **159** with a close fit so as to form a mechanical interlock between the upper tube-mounting member **44** (and the rear housing-member **22** in which it is mounted) and the upper end of the center-wall **32** of the front housing-member **21**, as indicated in FIGURES 4, 17, 18, 24 and 25.

The rear ends of the glass sleeves **74** and **61** are connected to the upstream and downstream sides (respectively) of the fluid-line whose rate of flow is to be measured. These connections may be made through the joint-construction hereinabove referred to as disclosed in the aforementioned co-pending application Ser. No. 47,703 or may be made by any other suitable hose-connections or pipe-connections, including any conventional connections, hose, tube or pipe connections.

The flow-meter may be disconnected from the mounting-plate **108** without disassembling the housing (**21** and **22**) and without disconnecting the flow-meter from the line whose rate-of-flow is being measured, by merely first disengaging the lower end of the plate **108** from the lower bushing **106** and then disengaging the upper end of the plate **108** from the upper bushing **106** by a vertical motion of the plate in relation to the bushing **104**.

To change the metering-tube **23** in the meter either for replacement or change of tube-size and/or to change the float, at least one end of the meter must be disconnected from the mounting-plate **108**. The latch **142** is then opened and then the two housing-members (**21** and **22**) are separated from each other in a longitudinal direction (parallel to the axis of the metering tube **23**) until the lower end of the metering-tube **23** has been disengaged from the lower nipple **45**; whereupon the metering-tube is slanted so as to clear the lower nipple and is then pulled down from the upper nipple **46**. By a reverse series of steps a new metering-tube may be inserted, and then the two housing members are moved towards each other until the detents **160** and **155** enter the notches or recesses **159** and **158**, respectively, and the latch **142** is thereupon closed.

In its complete or "housed" form shown in FIGURES 1, 2 and 4, the two housing-members **21** and **22** become parts of the meter connections, in the sense that they serve to keep the tube-mounting members **43** and **44** in spaced relation to each other, against any fluid pressure tending to separate them and against any force tending to misalign the nipples **45** and **46** thereof.

In the flow-meter of the present invention, the fluid comes into contact only with glass and the aforementioned chemically inert synthetic resin (preferably Teflon or Kel-F) of which the tube-mounting members **43** and **44** and the valve-stem **90** are formed.

In each instance, the primary seal between the cylindrical terminal bore-portions **47** and **48** of the metering-tube **23** and the corresponding nipples **45** and **46**, and between the valve-stem **90** and the glass bore-portion **85** are effected by the annular cylindrical sealing portions (**49** and **50**) of the nipples and the annular cylindrical sealing portion **97** of the valve-stem, bearing against the juxtaposed cylindrical bores of the metering-tube and of the lower glass sleeve, respectively, while a secondary seal is formed behind each such primary seal by an elastomer (Viton) O-ring operatively mounted in ring-receiving grooves behind such primary seals.

An arcuate latch **170** is pivoted to the bracket-plate **108** about a headed pivot member **171** as illustrated in FIGURES 14, 14A and 14B. The pivot member has a slight shoulder **172**, and the axial distance between such shoulder and the latch-engaging head of the pivot member is slightly greater than the thickness of the latch **170**, so that when the plate-entering end **173** of the pivot member **170** is riveted over or otherwise firmly secured in the anchorage-hole in the plate **108**, the latch **170** will be free to swing about the pivot. A thin washer **174** is interposed between the shoulder **172** and the rear surface of the mounting-plate **108**, to space the latch **170** from such rear surface. The latch **170** has an arcuate extent slightly greater than 180°, namely, of the order of 195° from the center of its pivot to the latching end thereof, so that when the latch is swung across the outer rubber flange of the rubber bushing **104**, it will engage such rubber flange with a significant interference-fit, whereby the latch **170** prevents the disengagement of the upper end of the plate **108** and the upper bushing **104** from each other. A similar latch may be mounted in operative juxtaposition to the lower rubber bushing **106**, but disposed (in relation to such bushing **106**) in a position which is 90° of the position of the upper latch **170**.

The following is a description of the method of mounting the glass sleeves **61** and **74** in the synthetic-resin tube-mounting members **44** and **43** (respectively).

The portions of the outer surfaces of the glass sleeves **61** and **74** which are within the corresponding synthetic-resin tube-mounting members **44** and **43** (respectively) are precision-ground to roughen such glass surfaces and also to dimension the respective outer diameters **64** and **76** thereof accurately to the effective over-size in relation to the initial (cold) diameters of the respective bore-portions **55** and **70** of the resin members **44** and **43**, so as to permit the efficacious heat-shrinking and epoxy-adhesion or bonding of the juxtaposed glass and resin surfaces to each other, as more fully described hereinafter.

Prior to the mounting of the glass sleeves and resin members to each other, the glass sleeves are devoid of the respective radial holes **63** and **78**; these holes being drilled after the resin members and the glass sleeves have been assembled to each other in the manner hereinafter described.

Prior to the assembly of the resin members **43** and **44** and the respective glass members **74** and **61**, the bores of the resin members are treated with a solution of anhydrous ammonia and an alkali metal such as sodium for a minute or so, namely, until a thin or very slight adherent carbon layer is formed on the bore-surfaces of the resin members; such carbon layer being recognizable by bore-surfaces gradually turning from their initially generally white color to a brown color of increasing degree of darkness as such treatment is continued.

The resin members are thereafter heated to a temperature of approximately 500° F. (more or less), thereby to cause the diameters of the bores thereof materially to expand or enlarge to an extent providing several thousandths of an inch clearance between the smaller bore-portion of the tube-mounting member and the outer ground cylindrical surface of the glass sleeve to be telescoped thereinto. Thus, for example, with the tube-mounting member formed of Teflon, the larger bore-portion **55** of the tube-mounting member **44** which has an original (cold) diameter of approximately .305" is expanded by about .013" to .318" when so heated, while the smaller bore-portion **59** thereof whose initial (cold) diameter is approximately .295" is expanded by about .0126" to .3076" when so heated. Similarly, the larger bore-portion **70** of the lower tube-mounting member **43** which has an original (cold) diameter of approximately .460" is expanded by about .0196" to .4796" when so heated, while the smaller bore-portion **73** thereof whose initial (cold) diameter is approximately .450" is expanded by about .019" to .469" when so heated. The smaller-diametered outer cylindrical surface **64** of the glass sleeve **61** which is telescoped into the upper tube-mounting member **44** is ground to a diameter of .305", which is .010" larger than the cold diameter of the smaller bore-portion **59** of the member **44** but is .0026" less than the heated diameter of such bore-portion. The portion of the glass

sleeve **61** which is outside and to the rear of tube-mounting member **44** and whose exterior cylindrical surface is left in its original glazed condition, has a diameter substantially greater than that of the ground exterior surface **64** of the glass sleeve **61** which is telescoped into the member **44**, as indicated, for instance, in FIGURE 4. The diameter of the outer cylindrical surface **76** of the lower glass sleeve **74** is ground to .460". This is .010" larger than the cold diameter of the smaller bore-portion **73** of the lower tube-mounting member **43** but is .009" smaller than its hot diameter of such bore-portion, thereby providing a .009" clearance for the aforementioned assembly with an epoxy-resin coating on the outer surface of the glass sleeve **74**, with sufficient of such epoxy-resin passing into the clearance between the larger diametered bore-portion **70** and the ground cylindrical glass surface **76** to form the epoxy layer **165** (FIGURE 4). These dimensions are illustrative, and represent relative dimensions or proportions which may be applied to meters of a size different from the illustrated in the drawings; wherein FIGURE 2 shows approximately the actual size of a meter embodying the present invention.

Either prior to or during the heating of the resin members **43** and **44**, the outer ground surfaces of the glass sleeves (which will ultimately be disposed within the resin members) are coated with an admixture of an adhesive or bonding epoxy-resin and a catalyst or accelerator therefor, such admixture having the consistency of approximately that of soft putty. Such coating is made sufficiently thick so that some of the resin will be scraped off (toward the rear ends of the glass sleeves) as the glass sleeves are later telescoped into the bores of the respective resin members **44** and **43**.

While the resin members **44** and **43** are at the aforementioned temperature, with their bores so expanded or enlarged, the glass sleeves **61** and **74** are telescoped thereinto from the rear ends towards the front ends of the resin members. During this insertion, some of the aforementioned epoxy-resin is scraped off toward the rear, and any excess is thus gathered around the exterior portions of the glass sleeves, just beyond the rear ends of the resin members (to be thereafter mechanically removed). However, because of the expansion of the bores of the resin members **44** and **43**, epoxy layers **164** and **165** are retained and disposed in the slight clearances between the bore-portions **55** and **70** (respectively) of the resin members **44** and **43** and the juxtaposed outer ground cylindrical surfaces of the glass sleeves **61** and **74** (respectively) and such epoxy layers form a bond between the glass and the synthetic resin tube-mounting members. A similar though thicker epoxy layer **166** is likewise formed in the smaller-diametered bore-portion **73** of the lower resin member **43** and the juxtaposed smaller-diametered outer surface **77** of the glass sleeve **74**.

After cooling and the removal of any excess epoxy resin which may be extruded exteriorly of the resin members **44** and **43**, the assemblies of the resin members and glass sleeves are permitted to cure, namely, are given sufficient time for the epoxy resin firmly to set and harden.

After the epoxy layers **164**, **165** and **166** have adequately hardened, the holes **63** and **78** are drilled through the side-walls of the respective glass sleeves **61** and **74**, by a diamond drill inserted through the respective fluid-passageways **57** and **72** in the nipples **46** and **45** of the resin members **44** and **43**.

By reason of the initially oversize of the diameter of the outer cylindrical glass surface **64** in relation to the bore-portion **59** and of the diameter of the outer cylindrical glass surface **76** in relation to the bore-portion **70**, and the subsequent shrinkage of these two-portions onto such oversized glass surfaces, no appreciable layer of epoxy-resin remains between the shrink-fitted contiguous cylindrical resin and glass surfaces through which the holes **63** and **78** are drilled; the epoxy resin being forced into the clearances provided therefor. Hence, the fluid being metered will not come in contact with the epoxy-resin.

The rubber bushings **104** and **106** are mounted on the respective rear exterior terminal portions **65** and **82** of the glass sleeves **61** and **74** after the glass sleeves and resin tube-mounting members **43** and **44** have been assembled to each other in the manner hereinabove described; the bushings **104** and **106** being made of low-durometer neoprene with sufficient stretchability to be stretchable over the pipe-coupling bells **66**. When so mounted, the bushings **104** and **106** are slideable along the outer or exposed glazed surfaces of the glass sleeves when substantial force is applied so to slide same, and form an interference-fit with such glass surfaced of sufficient magnitude adequately to mount and support the meter to and by the meter-mounting member **108**.

Having shown and described an embodiment of the invention, the following is claimed.

1. A tube type fluid meter including two spaced-apart tube-mounting members formed of a form-retaining though slightly resiliently-deformable non-brittle chemically-inert and solvent-resistant synthetic-resin having chemical and physical stability at temperatures at least up to 350° F. and capable of forming an unlubricated non-seizing and slideable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst, each tube-mounting member having a generally cylindrical tube connector for telescoping with an end of the below-mentioned metering-tube, each of said tube-connectors having a generally cylindrical fluid-sealing annulus integral therewith and projecting radially therefrom and being resiliently compressible in a radial direction for forming a radial fluid-seal with the below-mentioned glazed sealing surface of the metering-tube, each tube-mounting member having a bore therein and having a fluid-passageway extending through said tube-connector thereof and communicating with the bore thereof, glass metering-tube having generally cylindrical glazed sealing surfaces at its ends telescopically mounted to said tube-connectors with substantial interference-fit with the aforementioned integral fluid-sealing annuli thereof and resiliently compressing the latter in a radial direction and so demountably sealing the ends of said metering-tube to said tube-connectors and forming communication between the metering-tube and the aforementioned fluid-passageways thereof of said tube connectors, and a support demountably interconnecting said tube-mounting members and retaining them in operatively spaced relation to each other.

2. A tube type fluid meter including two spaced-apart tube-mounting members formed of a form-retaining though slightly resiliently-deformable non-brittle chemically-inert and solvent-resistant synthetic-resin having chemical and physical stability at temperatures at least up to 350° F. and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed surface when pressed thereagainst and having a coefficient of thermal expansion substantially greater than that of borosilicate glass, each tube-mounting member having an integral tube-connector having a generally cylindrical fluid-seal integral therewith and projecting therefrom and being resiliently compressible in a radial direction, each tube-mounting member having a sleeve-receiving bore therein and having a fluid-passageway extending through the tube-connector thereof and communicating with the bore thereof, a borosilicate glass sleeve immovably mounted in and permanently sealed to the bore of each tube-mounting member and communicating with the bore thereof, a glass metering-tube having generally cylindrical glazed sealing surfaces at its ends telescopically mounted to said tube-mounting members with substantial interference-fit with the aforementioned integral fluid-seals of the tube-connectors and resiliently compressing such integral fluid-seals in a radial direction

and so demountably sealing the ends of said metering tube to said tube-connectors and forming communication between the metering-tube and the aforementioned fluid-passageways thereof, and a support demountably interconnecting said glass sleeves and retaining them and the tube-mounting members in operatively spaced relation to each other.

3. A tube type fluid meter according to claim 1, in which the synthetic-resin of which the tube-mounting members are formed is a fluoro-carbon, and in which each of the tube-mounting members has a tube-receiving nipple extending therefrom with which the ends of the metering-tube are telescoped with the interference-fit and through which nipples the fluid-passageways extend.

4. A tube type fluid meter according to claim 2, in which the synthetic-resin of which the tube-mounting members are formed is a fluoro-carbon, and in which each of the tube-mounting members has a tube-receiving nipple extending therefrom with which the ends of the metering-tube are telescoped with the interference-fit and through which nipples the fluid-passageways extend.

5. A tube type fluid meter including two spaced-apart tube-mounting members formed of a form-retaining though slightly resiliently-deformable non-brittle chemically-inert and solvent-resistant synthetic resin having chemical and physical stability at temperatures substantially above the boiling point of water and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst, each tube-mounting member having an annular and generally cylindrical and radially compressible tube-seal integral therewith and having a sleeve-receiving bore therein and having a fluid-passageway communicating with the bore thereof, a glass sleeve immovably mounted in and permanently and fixedly sealed to the bore of each tube-mounting member and having a hole through the wall thereof in registration with the fluid-passageway thereof, a metering-tube having generally cylindrical glazed sealing surfaces at its ends telescopically mounted to said annular tube-seals of said tube-mounting members and communicating with the aforementioned fluid-passageways thereof and demountably sealed thereby with substantial interference-fit therewith, and a support demountably interconnecting said tube-mounting members and retaining them in operatively spaced relation to each other.

6. A tube type fluid meter including two spaced-apart tube-mounting members in generally vertical alignment with each other when in use, said tube-mounting members being formed of a form-retaining though slightly resiliently-deformable non-brittle chemically-inert and solvent-resistant synthetic resin having chemical and physical stability at temperatures substantially above the boiling point of water and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst, each tube-mounting member having a sleeve-receiving bore therein and having a fluid-passageway disposed transversely of and communicating with the bore thereof, and each of said tube-mounting members having an integral radially-acting tube-sealing annular portion operatively disposed in relation to the fluid-passageway thereof, a glass sleeve mounted in and sealed to the bore of each tube-mounting member and having a hole through the wall thereof in registration with the fluid-passageway thereof, a metering-tube having its ends telescopically mounted to said tube-mounting members and communicating with the aforementioned fluid-passageways thereof and demountably sealed thereto by the aforementioned radially-sealing annular portions thereof with substantial interference fit therewith, and a demountable support interconnecting said tube-mounting members and retaining them in operatively spaced relation to each other.

7. A tube type fluid meter including two spaced-apart tube-mounting members formed of a form-retaining though slightly resiliently-deformable non-brittle chemically-inert and solvent-resistant synthetic resin having chemical and physical stability at temperatures substantially above the boiling point of water, and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst, each tube-mounting member having a sleeve-receiving bore therein and including a tube-connector with a fluid-passageway therethrough communicating with the bore thereof, said tube-connectors facing and being co-axial with each other, and each of said tube-connectors having an integral annular radially-acting and radially compressible tube-seal for forming a demountable fluid-seal with an end of a metering-tube when such tube-connector and such tube-end are telescoped in relation to each other, a glass sleeve immovably mounted in and permanently sealed to the bore of each tube-mounting member and having a hole through the wall thereof in registration with the fluid-passageway thereof, a glass metering-tube having generally cylindrical glazed sealing surfaces at its ends and telescopically mounted to said tube-connectors and demountably sealed thereto by the aforementioned radially-sealing annular portions thereof with substantial interference fit therewith, and a support demountably interconnecting said tube-mounting members and retaining them in operatively spaced relation to each other.

8. A tube type fluid meter including an elongated tube-encasing and tube-supporting housing adapted to be vertically disposed when in use, said housing having a transparent front wall, a socket in each end of said housing, extending transversely thereof, a tube-mounting member removably mounted in each of said sockets, said tube-mounting members being formed of a form-retaining though slightly resiliently-deformable chemically-inert and solvent-resistant non-brittle synthetic resin having chemical and physical stability at temperatures at least up to about 350° F. and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst and having a coefficient of thermal expansion substantially greater than that of glass, each of said tube-mounting members having a sleeve-receiving bore therein, said tube-mounting members having facing co-axial fluid-passageways communicating with the respective bores thereof, a glass sleeve immovably mounted in and permanently sealed to the bore of each tube-mounting member and having a hole through the wall thereof in registration with the fluid-passageway thereof, a metering-tube having its ends telescopically mounted to said tube-mounting members in communication with the aforementioned fluid-passageways thereof and demountably sealed thereto with substantial interference-fit therewith.

9. A tube type fluid meter including an elongated tube-encasing and tube-supporting housing formed of an impact-resistant synthetic resin which is harder than the below mentioned tube-mounting members, said housing being adapted to be vertically disposed when in use, said housing having a transparent front wall, a socket in each end of said housing, extending transversely thereof, a tube-mounting member removably mounted in each of said sockets, said tube-mounting members being formed of a form-retaining though slightly resiliently-deformable chemically-inert and solvent-resistant non-brittle synthetic resin having chemical and physical stability at temperatures at least up to about 350° F. and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst and having a coefficient of thermal expansion substantially greater than that of glass, each of said tube-mounting members having a sleeve-receiving bore therein, said tube-mounting members having facing co-axial fluid passageways communicating with the respective bores thereof, a glass sleeve mounted in and immovably sealed to the bore of each tube-

mounting member and having a hole through the wall thereof in registration with the fluid-passageway thereof, a metering-tube having its ends telescopically mounted to said tube-mounting members in communication with the aforementioned fluid-passageways thereof and demountably sealed thereto with substantial interference-fit therewith.

10. A tube type fluid meter including an elongated tube-encasing and tube-supporting housing formed of an impact-resistant synthetic resin which is harder than the below mentioned tube-mounting members, said housing being adapted to be vertically disposed when in use, said housing having a transparent front wall, a socket in each end of said housing, extending transversely thereof, a tube-mounting member removably mounted in each of said sockets, said tube-mounting members being formed of a form-retaining though slightly resiliently-deformable chemically-inert and solvent-resistant non-brittle synthetic resin having chemical and physical stability at temperatures at least up to about 350° F. and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst and having a coefficient of thermal expansion substantially greater than that of glass, each tube-mounting member having a sleeve-receiving bore therein and including a tube-connector with a fluid-passageway therethrough communicating with the bore thereof, said tube-connectors facing and being co-axial with each other, and each of said tube-connectors having an integral annular radially-acting tube-seal for forming a demountable fluid-seal with an end of a metering-tube when such tube-connector and such tube-end are telescoped in relation to each other, a glass sleeve mounted in and sealed to the bore of each tube-mounting member and having a hole through the wall thereof in registration with the fluid-passageway thereof, a metering-tube having its ends telescopically mounted to said tube-connectors and demountably sealed thereto by the aforementioned radially-sealing annular portions thereof with substantial interference fit therewith.

11. A tube type fluid meter including a two-part housing for quick and ready disassembly and re-assembly comprising two similar and co-extensive channel-shaped housing-members formed of an impact-resistant synthetic resin, each housing-member being in the form of a channel at least one end of which is closed, a transverse socket in each end of said two-part housing, a tube-mounting member removably mounted in each of said sockets, said tube-mounting members being formed of a form-retaining though slightly resiliently deformable chemically-inert and solvent-resistant synthetic-resin having chemical and physical stability at temperatures at least up to about 350° F. and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst and having a coefficient of thermal expansion substantially greater than that of glass, each tube-mounting member having a sleeve-receiving bore therein and including a tube-connector with a fluid-passageway therethrough communicating with the bore thereof, said tube-connectors facing and being co-axial with each other, and each of said tube-connectors having an integral annular radially-acting tube-seal for forming a demountable fluid-seal with an end of a metering-tube when such tube-connector and such tube-end are telescoped in relation to each other, a glass sleeve mounted in and immovably sealed to the bore of each tube-mounting member and having a hole through the wall thereof in registration with the fluid-passageway, and a metering-tube having its ends telescopically mounted to said tube-connectors and demountably sealed thereto by the aforementioned radially-sealing annular portions thereof with substantial interference-fit therewith.

12. A tube type fluid meter including a two-part housing comprising two generally identical half-housing members each being in the form of a channel open at one end and closed at the other end, with the closed end of each juxtaposed to the open end of the other, a closure-extension extending transversely from each closed end on the open side of the channel and overlapping the open end of the other half-housing to form a closure therefor when the two channel-shaped housing members are operatively juxtaposed to each other with the edges of the side-walls thereof adjacent to each other and with the open end of each juxtaposed to the closed end of the other, interlocking means associated and integral with the aforementioned closure-extension of each housing-member and with the open end of the other housing member, said interlocking means being so arranged that when the two housing members are placed against each other with the edges of the side-walls thereof adjacent to each other and with the closure-extension of each spaced from the open end of the other by a distance at which such interlocking means are disengaged and the two housing-members are then moved longitudinally with respect to each other with the open end of each moved towards the closure-extension of the other, said interlocking means will form an interlocking engagement between the open end of each housing-member with the closure-extension of the other housing-member against lateral separation of the two housing-members transversely of the main longitudinal dimension thereof, a socket in each end of said two-part housing, a chemically-inert synthetic resin tube-mounting member removably mounted in each of said sockets, each of said tube-mounting members having a bore therein, facing co-axial tube-connector means extending from said tube-mounting members and having fluid passageways therethrough extending and into the aforementioned bores, each tube-mounting member having a bore therein and including tube-connector means with a fluid-passageway therethrough communicating with the bore thereof, said tube-connector means facing and being co-axial with each other, and each of said tube-connector means including an integral annular radially-acting tube-seal for forming a demountable fluid-seal with an end of a metering-tube when such tube-connector means and such tube-end are telescoped in relation to each other, a metering-tube having its ends telescopically mounted to said tube-connector means and demountably sealed thereto by the aforementioned radially-sealing annular portions thereof with substantial interference-fit therewith.

13. A tube type fluid meter including two spaced-apart and vertically-aligned tube-mounting members formed of a form-retaining though slightly resiliently-deformable non-brittle chemically-inert and solvent-resistant synthetic resin having chemical and physical stability at temperatures substantially above the boiling point of water and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst, each tube-mounting member having a bore therein and including tube-connector means with a fluid-passageway therethrough communicating with the bore thereof, said tube-connector means facing and being co-axial with each other, and each of said tube-connector means including an integral annular radially-acting tube-seal for forming a demountable fluid-seal with an end of a metering-tube when such tube-connector means and such tube-end are telescoped in relation to each other, a glass metering-tube having generally cylindrical glazed sealing surfaces at its ends telescopically mounted to said tube-connector means and demountably sealed thereto by the aforementioned radially-sealing annular portions thereof with substantial interference-fit therewith, and a support demountably interconnecting said tube-mounting members and retaining them in operatively spaced relation to each other.

14. A tube type fluid meter according to claim **13** in which the interference-fit between the upper tube-connector means and the metering-tube is greater than the interference-fit between the lower tube-connector means

and the metering-tube, whereby the metering-tube will separate from the lower tube-connector means when the two tube-mounting members are moved axially apart from each other from their operative positions, without the metering-tube separating from the upper tube-connector means.

15. A tube type fluid meter including a two-part elongated tube-encasing and tube-supporting housing comprising two housing members, each extending substantially the entire length of the housing, a transverse socket in each end of said housing, a tube-mounting member removably mounted in each of said sockets, said housing-members, sockets and tube-mounting members being so arranged that when the tube-mounting members are mounted in their respective sockets, they prevent the separation of the two housing-members at least in one direction in which they are otherwise separable, each of said tube-mounting members having a bore therein and having tube-connector means including an integral annular radially-acting tube-seal for forming a demountable fluid-seal with the end of a metering-tube when the latter is telescoped in relation thereto, and a metering-tube having its ends telescopically mounted to said tube-connector means and demountably sealed thereto by the aforementioned radially-acting tube-seals thereof with substantial interference-fit therewith.

16. A tube type fluid meter including a two-part tube-encasing and tube-supporting housing comprising two housing members, each extending the entire length of the housing, a transverse socket in each end of said housing, interlocking means associated with the juxtaposed ends of the two housing members at each end of the housing and arranged demountably to interlock said two housing members against separation thereof transversely of their main meeting plane, a socket in each end of said housing, a tube-mounting member removably mounted in each of said sockets, said housing-members, sockets and tube-mounting members being so arranged that when the tube-mounting members are mounted in their respective sockets, they prevent the separation of the two housing-members in a direction parallel to the main meeting plane of the housing members and normal in the main longitudinal direction thereof, a separable fastener means operatively interposed between said two housing members and arranged to prevent the separation of the two housing members in the longitudinal direction thereof, each of said tube-mounting members having a bore therein and having tube-connector means including an annular tube-seal for forming a demountable fluid-seal with the end of a metering-tube when the latter is telescoped in relation thereto, and a metering-tube having its ends telescopically mounted to said tube-connector means and demountably sealed thereto by the aforementioned tube-seals thereof.

17. A tube type fluid meter including a two-part housing comprising two similar channel-shaped housing-members, each open at one end and closed at the other end, with the closed end of each housing-member juxtaposed to the open end of the other housing-member, a closure-extension extending transversely from the closed ends of each housing-member on the open side of the channel thereof and overlapping the open end of the outer housing-member to form a closure therefor when the two channel-shaped housing-members are operatively juxtaposed to each other with the edges of the sidewalls thereof adjacent to each other and with the open end of each juxtaposed to the closed end of the other, interlocking means associated and integral with the closure-extension of each housing-member and with the open end of the other housing-member, said interlocking means being so arranged that when the two housing-members are placed against each other with the edges of the sidewalls thereof adjacent to each other and with the closure-extension of each spaced from the open end of the other by a distance at which such interlocking means are disengaged and the two housing-members are then moved longitudinally with respect to each other with the open end of each moved towards the closure-extension of the other, said interlocking means will form an interlocking engagement between the open end of each housing-member with the closure-extension of the other housing-member against lateral separation of the two housing-members transversely of the main longitudinal dimension of the housing, a socket in each end of said two-part housing, a chemically-inert synthetic-resin tube-mounting member removably mounted in each of said sockets, each of said tube-mounting members having a sleeve-receiving bore therein, facing co-axial tube-receiving nipples extending from said tube-mounting members and having fluid passageways therethrough extending and into the aforementioned bores, glass sleeves permanently mounted in said bores and sealed thereto and having portions thereof extending exteriorly of said tube-mounting members for connection with a fluid line and having radial holes through the wall thereof in registration with the aforementioned nipple-passageway and a metering-tube having its ends telescopically mounted to said nipples and removably sealed thereto with substantial interference-fit therewith.

18. A tube type fluid meter according to claim 17 in which said tube-mounting members and sockets therefor are so arranged that when the tube-mounting members are operatively mounted in their respective sockets, such tube-mounting members lock the two housing-members in relation to each other horizontally in the main meeting plane thereof.

19. A tube type fluid meter according to claim 17, including separable fastener means intermediate said two housing-members and arranged to fasten the same to each other against separation in the longitudinal direction thereof and to permit such separation when such fastener means is in its inoperative position.

20. A tube type fluid meter according to claim 18, including separable fastener means intermediate said two housing-members and arranged to fasten the same to each other against separation in the longitudinal direction thereof and to permit such separation when such fastener means is in its inoperative position.

21. A tube type fluid meter according to claim 17, in which one of the glass sleeves is open at both ends and includes a valve-seat, and in which a chemically inert synthetic resin valve-stem is disposed within said glass sleeve in operative juxtaposition to said valve-seat thereof and arranged to control the flow of flow through said glass sleeve and the tube-mounting meter thereof.

22. A tube type fluid meter including a two-part housing comprising two similar and complementary channel-shaped housing-members formed of a hard impact-resistant synthetic resin, each housing-member being open at one end and closed at the other end, with the closed end of each juxtaposed to the open end of the other, a closure-extension extending transversely from each closed end on the open side of the channel and overlapping the open end of the other half-housing to form a closure therefor when the two channel-shaped housing members are operatively juxtaposed to each other with the edges of the side-walls thereof adjacent to each other and with the open end of each juxtaposed to the closed end of the other, interlocking means associated and integral with the aforementioned closure-extension of each housing-member and with the open end of the other housing member, said interlocking means being so arranged that when the two housing members are placed against each other with the edges of the side-walls thereof adjacent to each other and with the closure-extension of each spaced from the open end of the other by a distance at which such interlocking means are disengaged and the two housing-members are then moved longitudinally with respect to each other with the open end of each moved towards the closure-extension of the other, said interlocking means will form an interlocking engagement between the open end of each housing-member with the closure-extension

of the other housing-member against lateral separation of the two housing-members in a direction normal to the main meeting plane thereof, a socket in each end of said two housing-members, a tube-mounting member removably mounted in each of said sockets, said tube-mounting members being formed of a form-retaining though slightly resiliently-deformable chemically-inert and solvent-resistant synthetic-resin having chemical and physical stability at temperatures up to at least 500° F. and having a high coefficient of thermal expansion, each of said tube-mounting members having a sleeve-receiving bore therein, facing co-axial tube-receiving nipples extending from said tube-mounting members and having fluid-passageways therethrough and extending into the aforementioned bores, glass sleeves mounted in said bores and sealed thereto and having portions thereof extending exteriorly of said tube-mounting members for connection with a fluid line, each of said glass sleeves having a hole through the wall thereof in registration with the corresponding nipple-passageway mentioned above, and a metering-tube having its ends telescopically mounted to said nipples and demountably sealed thereto with substantial interference-fit therewith.

thereto and having portions thereof extending exteriorly

23. A tube type fluid meter including two spaced-apart tube-mounting members formed of a form-retaining though slightly resiliently-deformable non-brittle chemically-inert and solvent-resistant synthetic resin having chemical and physical stability at temperatures substantially above the boiling point of water and capable of forming an unlubricated non-seizing and slidable fluid-sealing contact with a matchingly-shaped glazed glass surface when pressed thereagainst, each tube-mounting member having a sleeve-receiving bore therein and having a fluid-passageway communicating with the bore thereof, a glass sleeve mounted in and sealed immovably to the bore of each tube-mounting member and having a hole through the wall thereof in registration with the fluid-passageway thereof and having a terminal portion thereof extending exteriorly of the tube-mounting member for connection with a fluid line, a glass metering-tube having generally cylindrical glazed sealing surfaces at its ends telescopically mounted to said tube-mounting members and communicating with the aforementioned fluid-passageways thereof and demountably sealed thereby with substantial interference-fit therewith, a resilient shock-absorber on the exterior portion of each of said glass sleeves, and a support demountably interfitting with said shock-absorbers and interconnecting said two tube-mounting members and maintaining them in operatively spaced relation to each other.

24. A tube type fluid meter according to claim **23**, including a table-supported base having a support-receiving socket for demountably receiving the lower end of the support which interconnects the two tube-mounting members, and locking means arranged releasably to lock the lower end of said support in said support-receiving socket.

25. A tube type fluid meter according to claim **23**, including a rod detachably secured to the support which interconnects the two tube-mounting members at a right angle to such support, for detachably mounting such support to a laboratory apparatus rack.

26. A tube type fluid meter including two vertically-aligned spaced-apart tube-mounting members each formed of a generally form-retaining, non-brittle and slightly resilient synthetic resin, each tube-mounting member having a bore therein and having integral tube-connector means arranged telescopically to receive one end of a metering tube, each of said tube connector means including a generally cylindrical and radially compressible sealing annulus integral therewith, a glass metering-tube having generally cylindrical glazed sealing surfaces at its ends telescopically mounted to said tube-connector means and forming a primary fluid-seal with said sealing annuli, radially-sealing O-rings operatively mounted between the tube-connector means and the telescoped ends of the metering-tube, said O-rings being closer to the ends of the metering-tube than the aforementioned sealing annuli and forming a demountable secondary fluid-seal between said tube-mounting members and the telescoped ends of the metering-tube, and a support demountable interconnecting said tube-mounting members and retaining them in operatively spaced relation to each other.

27. A tube type fluid meter including two vertically-aligned spaced-apart tube-mounting members each formed of a generally form-retaining, non-brittle and slightly resilient synthetic resin, each tube-mounting member having a bore therein and having integral tube-connector means arranged telescopically to receive one end of a metering-tube, each of said tube-connector means including a generally cylindrical and radially compressible sealing annulus integral therewith and arranged to form a primary seal with the metering-tube, a ring-receiving groove in each of said tube-connector means nearer the ends of the metering-tube than the aforementioned sealing annuli, a glass metering-tube having generally cylindrical glazed sealing surfaces at its ends telescopically mounted to said tube-connector means, an O-ring operatively mounted in each of said ring-receiving grooves and bearing radially against the corresponding telescoped end of the metering-tube and forming a demountable secondary fluid-seal between said tube-mounting members and the telescoped ends of the metering-tube, and a support demountably interconnecting said tube-mounting members and retaining them in operatively spaced relation to each other.

28. A tube type fluid meter according to claim **26**, including a revolvable fluid-throttling valve-member operatively mounted in one of said tube-mounting members and arranged for incrementally varying the rate of flow of fluid through the meter.

29. A tube type fluid meter according to claim **26**, including a fluid-conducting glass sleeve operatively mounted in the bore of each of the tube-mounting members and communicating with the tube-connector means thereof, each of said glass sleeves having a line-connector portion extending exteriorly of the tube-mounting member.

30. A tube type meter according to claim **29**, including a revolvable fluid-throttling valve-member screw-threadedly mounted in one of said glass sleeves and arranged for incrementally varying the rate of flow of fluid through the meter.

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