

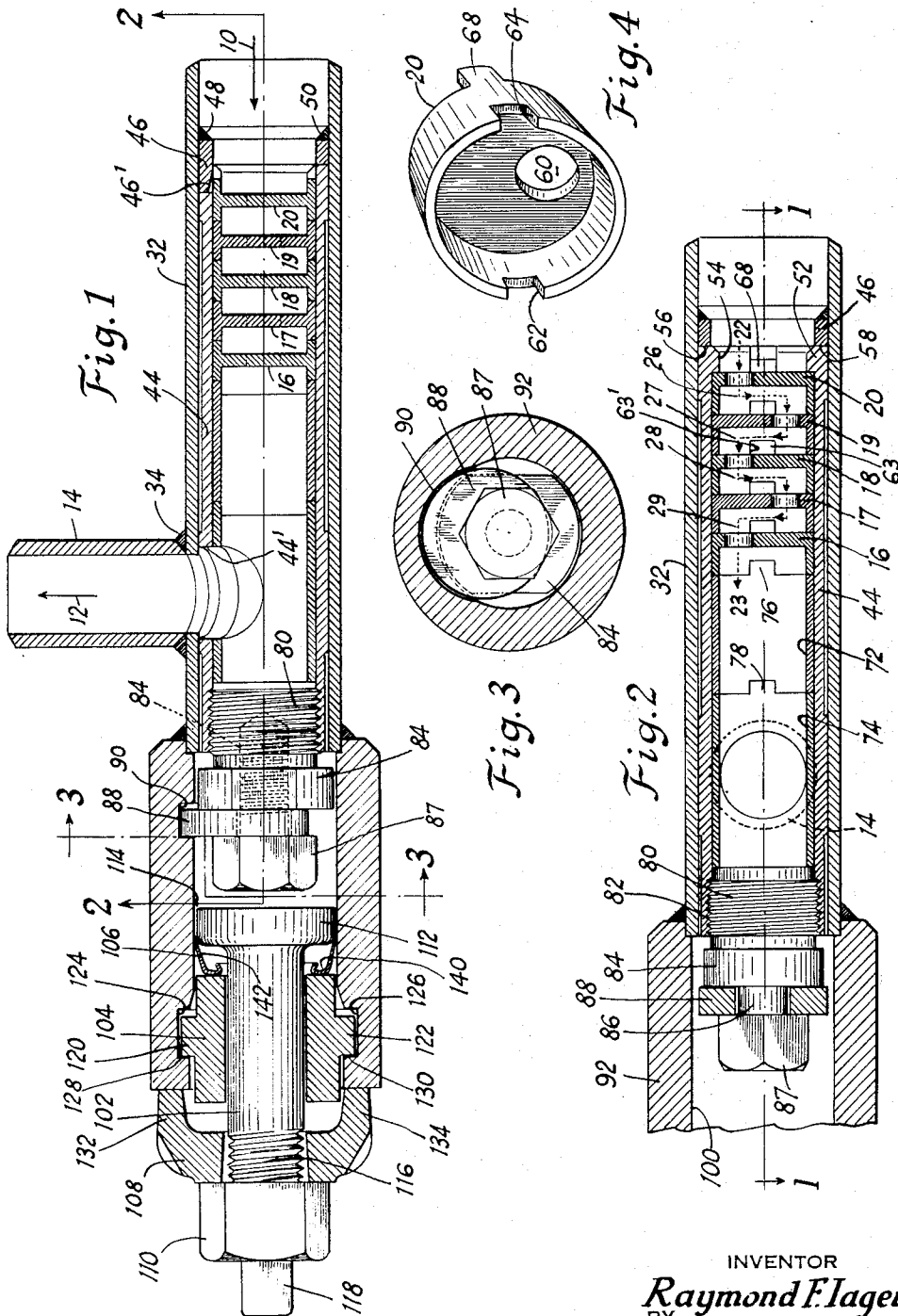
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FLUID CIRCUIT RESISTOR CONSTRUCTION

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## FLUID CIRCUIT RESISTOR CONSTRUCTION

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This invention involves fluid flow means for varying or controlling conditions pertaining to the flow of fluid under pressure in a confined stream.

The invention is particularly advantageous in fluid heat exchange installations which involve a plurality of fluid lines arranged in parallel between a common inlet and a common outlet. Examples of such installations are high pressure steam generators of the water tube type; hydrocarbon refining plants, and industrial plants for the manufacture or treatment of chemicals or other fluids under pressure. In the parallel circuits of such installations, it is important to maintain certain relationships of conditions in the adjacent circuits. For example, one circuit, of a plurality of circuits, may become subject to such flow conditions that there arises flow inequalities between this circuit and the others, and it is important to be able to correct this condition expeditiously, and without interfering with the main fluid line components such as different tube sections which are subject to different temperatures or other fluid conditions. The present invention provides for the accomplishment of such results.

Still more specifically, the invention consists of a tubular resistor adapted to be installed in a fluid flow line of piping or conduits and constructed with a number of quickly removable flow resistor elements. Each of these tubular resistors is also so constructed that access may be readily had to the interior of the structure without interfering with the tubular components which normally connect the resistor into an operative flow line or circuit, such access, and the character of the structure, permitting the quick addition to or subtraction from, the number of interior resistor elements which determine the total effect of the construction upon the pertinent fluid flow line. By way of example, the illustrative resistor is employed in the steam generator indicator in the pending patent application of Kessler and Ammon, Serial Number 15,178, filed on March 16, 1948.

In the steam generator of the Kessler and Ammon patent application, there are a number of long metal conduits leading from the water inlet zone at the base of the installation. Some of these tubes lead through furnace zones of different temperatures in which different conditions may arise to affect the relationship of the fluid flows through the different conduits. Resistors of the type of the present disclosure are arranged at the inlets of these conduits in order that such conditions may be corrected, or for the purpose

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of otherwise changing the relationships of the flows of the different conduits. In such an installation, it is an important desideratum that once the resistors have been adjusted to certain relative values, that they shall remain in that relationship and not be subject to inadvertent or unauthorized changes. Among the results accomplished by the present invention is the provision of a resistor having such attributes.

Another object of the invention is to provide a fluid flow resistor of the type indicated, having such a construction that the time required for adjusting the changing of the flow resistance is minimized. It is to be appreciated that this is of considerable importance in an installation which involves a large number of the illustrative resistors. The internal removable cartridge construction attains this object by providing a single internal construction which can be removed from the outer housing, placed upon a work bench, and quickly adjusted above or below certain values by the addition to, or subtraction therefrom of a number of orifice plates in the cartridge construction prior to its replacement in the housing.

It is appreciated that different kinds of fluid flow resistors have been suggested in the prior art. Such suggestions involve resistors of the strainer type having a multiplicity of small orifices in a single plate or diaphragm. Resistors of the needle valve type have also been suggested, as have those involving ferrules and long tubular coils. One difficulty of the resistors of the needle valve type is that they are subject to inadvertent or unauthorized changes which may have a serious effect upon the operation of the installation in which such resistors are used. Again, resistors of this type and other types presenting small orifices are subject to large pressure drops and high rates of wear. In contrast, the resistor of this invention involves orifices of large diameter which can be used because of the specific construction involved. The pressure drop through such orifices are inversely proportional to the fourth power of the diameter of the orifice, therefore, the minimization of wear resulting from the use of the pertinent orifices is substantial.

A preferred embodiment of the invention is illustrated in the accompanying drawings, and further objects of the invention will appear as the description of the invention proceeds.

In the drawings:

Fig. 1 is a longitudinal section on the plane indicated by the line 1—1 of Fig. 2, that plane being at right angles to the plane of Fig. 2;

Fig. 2 is a partial longitudinal section on the

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plane indicated by the line 2—2 of Fig. 1, and at right angles to the plane of Fig. 1;

Fig. 3 is a transverse section on the line 3—3 of Fig. 1, showing the manner in which the removable cylinder or cartridge construction is anchored against lengthwise movement relative to the resistor housing; and

Fig. 4 is an isometric view of one of the several orifice plate elements embodied in the resistor construction.

The entire resistor assembly indicated in Fig. 1 of the drawings is adapted for insertion in a high pressure fluid line in which the fluid flow into the resistor is indicated by the arrow 10 in Fig. 1, and the flow out of the resistor construction is indicated by the arrow 12 in the side outlet connection 14. The flow between the positions of the arrows 10 and 12 proceeds through the orifice plates 16—20, and their pertinent orifices, in the directions indicated by the dotted line 22—23 of Fig. 2, and the associated arrows 26—29.

Thus, the illustrative construction is not subject to the continuation or carry-through of the velocity of fluid from one orifice directly to another. In other words, the velocity from one orifice is dissipated before the next orifice is reached. Such velocity dissipation is effected by the axial offsetting of adjacent orifices and also by the interposition of the orifice plate pressure chambers between successive orifices.

The illustrative resistor includes a tubular housing 32 to which the outlet connection 14 is welded as indicated at 34. Slidably, but tightly fitted within the resistor housing is a removable inner cartridge construction which carries the several orifice plates 16—20 in a unitary manner. This inner cartridge construction includes a removable inner cylinder or tube 44 with its right hand end abutted against the notched ring 46 which is welded within the housing 32 at the positions indicated at 48 and 50. At diametrically opposite positions, the right hand end of this removable inner cylinder has radially inwardly extending projections 52 and 54 (Fig. 2) providing shoulders against which the inner end of the first orifice plate 20 is abutted.

The right hand end of the cylinder is also formed with a notch to receive the axially extended lug 46' on the ring 46 (Fig. 1) to correctly position the cartridge construction within the housing 32 so that the opening 44' is aligned with the lateral outlet connection 14.

The orifice plates are constructed as indicated in Fig. 4, but with the orifices of successive plates, such as the orifice 60, being disposed oppositely with reference to the diametrically opposite aligning slots such as 62, 63, and 64. For example, the orifice plate construction 20 will have its orifice positioned below its aligning slot 62 and the next plate 18 will have its orifice above its aligning slots.

Each orifice plate construction is also provided with an aligning projection or pin such as that shown at 68 in Fig. 4. This particular aligning pin is also indicated in Fig. 2 as being disposed in a slot or groove between the spaced inward projections 52 and 54 of the removable inner cylinder 44. The Fig. 2 relationship of the orifices of orifice plates 18 and 19 is maintained by the fitting of the aligning pin 63' of orifice plate construction 18 into an aligning slot 62 or 64 of the orifice plate construction 19.

The remaining orifice plates are similarly held in their operative positions, and the orifice plate

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constructions are held closely arranged at the left hand end of the cartridge by interlocking spacers or make-up rings such as 72. The spacer 72 has an aligning projection 76 fitting within an aligning slot of the orifice plate construction 16 and the spacer 74 has an aligning projection 78 fitting within an aligning slot in the spacer 72.

All of the orifice plate constructions and the spacers 72 and 74 are held in closely assembled condition by a plug 80 which is screw-threaded (82) into the left hand end of the inner cylinder to tightly abut against the end of spacer 74. This plug has an enlarged head 84 which is internally threaded to receive the set screw 86. Interposed between the head 87 of the set screw and the enlarged head 84 of the plug 80 is a ring 88 with an eccentric opening through which the stem of the set screw is disposed. The outer edge of this ring extends into a crescent slot 90 in the interior surface of the bore of a tubular breech block head 92 to prevent longitudinal movement of the cartridge construction relative to the resistor housing. This construction co-operates with the projection 46' and its notch in such a way that the entire cartridge construction cannot be locked in its operative position until it is properly disposed relative to the outlet 14.

There is associated with the breech block head 92, a pressure sealing device to prevent a fluid leakage from the resistor at high pressures and at the same time provide for easy access to the internals of the resistor for the purpose of adding one or more orifice plates or withdrawing one or more. This pressure sealing device provides a closure for the bore 100 of the head 92. It includes five main parts. These are, respectively, the retainer 102, the gland structure 104, the metallic gasket 106, the binder 108 and the nut 110 which is screw-threaded upon the left hand end of the retainer to hold the parts of pressure sealing device in operative condition.

The retainer 102 has a cylindrical body, one end of which is enlarged to form the head 112. The diameter of this head is slightly less than the diameter of the bore 100 so as to provide the annular opening as indicated at 114 between the head 112 and the bore 100. This opening may be termed a sealing opening. The outer end of the retainer is formed with screw threads 116 to receive the nut 110, and beyond the screw-threaded portion 116, there is an integral stud 118 preferably of square or hexagonal shape for the application of a wrench or other holding or turning tool.

Mounted upon the cylindrical portion of the retainer is the gland structure 104 which has diametrically opposite radial extensions 120 and 122 normally adapted to be seated within the recesses 124 and 126 within the head 92. Under operative conditions, the outer radial faces of the extensions 120 and 122 are pressed against the inner radial faces of inward extensions 128 and 130 which are integral with the head 92. The latter extensions do not extend circumferentially throughout 360°, but they leave circumferential openings of an extent greater than the circumferential width of extensions 120 and 122 so that the gland construction is associated with the remainder of the pressure sealing construction in the manner indicated in United States patent to Hamilton—2,342,140.

The gland structure 104 is normally prevented from accidentally turning by an axial extension of the binder, similar to that indicated at 44 in Figs. 4 and 6 of the above indicated Hamilton

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patent. The binder 108 has arms 132 and 134 resting against the end surface of the head 92. The binder is held in its operative position by abutment against the inner end of the nut 110.

The inner annular face of the gland structure 104 is normal to the longitudinal axis of the entire sealing structure and it receives the thrust of the annular flange 140 of the sheet metal gasket 106. This gasket, beyond this flange, is preferably of conoidal formation, presenting the outer flange 142 which is formed with a wedge shaped rim portion. This portion is adapted to be forcibly seated within the annular sealing space 114 by the axial reaction of the inner face of the gland structure 104 against the gasket flange 140. The gasket being additionally strengthened by the inner flange 144 to effectively receive the pertinent reaction.

The thrust which causes the outer flange of the gasket 106 to effect the pressure tight seal between the retainer head 112 and the bore 100 is caused by the turning of the nut 110 so as to move the retainer head outwardly or to the left in Fig. 1.

In such an installation as that shown in the Kessler and Ammon pending patent application, the tubular housing 32 of the illustrative resistor has the right hand end of its housing 32 rigidly connected, as by welding, with a part of one of the tubular steam generating circuits, and the lateral outlet connection 14 of each resistor is likewise rigidly secured to a coacting part of the same tubular circuit. The resistor construction is preferably disposed with its major axis in a horizontal position so that the removal of the cartridge construction is facilitated.

When it is desired to change the value of the flow resistance of the illustrative resistor construction, a nut 110 is backed off by turning it relative to the threaded stem 102 so that the pressure of the gasket 106 against the bore of the component 92 is relieved, as well as the pressure of the projections 120 to 122 against the shoulders 128 and 130. Upon the release of these pressures, the elements 104 may be partially rotated so that the projections 120 and 122 aligned with axially extending slots in the left hand end of the body 92. This permits the entire pressure sealing assembly including parts 112, 102, 110, 108, 104 to be removed as a unit. Thereupon, the nut 87 is turned to release the pressure upon the element 88 and permit the latter to be moved from the cross slot 90. When this is done, the entire cartridge assembly including the cylindrical shell 44 and its contents may be slidably withdrawn through the opening at the right hand end of the entire assembly.

After the cartridge is withdrawn as indicated above, it may be placed upon the work bench, secured in a vise, to facilitate further operations. A wrench is applied to the head 84 to back off the screw threaded plug which normally abuts the left hand end of the spacer 74. When this plug is removed the spacers 74 and 72 are slidably moved to the left and withdrawn from the cylinder 44. If the prior resistance value of the resistors is to be decreased, one or more of the orifice plates such as 16, 17, and 18 may be removed and a spacer member similar to spacer 72 substituted therefor, interlocking with the orifice plates in the manner previously described.

If, however, the resistance value of the assembly is to be increased, one or more orifice plates are added to the number of plates within the cartridge. As shown, the spacer element 72 occupies the actual space of three orifice plate

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constructions. Therefore, if three additional elements are added, no spacer element need be substituted for the element 72. However, it is to be appreciated that the spacer element 72 may have substituted therefor, a spacer element of the width of one or two of the orifice plate constructions.

After the desired changes in one of the orifice plate constructions are made and the spacer 74 is inserted in the position shown in Fig. 2, with all of the elements to its right inter-locked in the indicated manner, the plug 80 is screw-threaded tightly into the left hand end of the cartridge construction until it tightly abuts against the spacer 74 to hold all of the cartridge internals in their operative positions. The cartridge construction is then moved into the housing 32 until it abuts against the ring 46. It is then turned until the projection 46' of the ring 46 is seated within its corresponding recess in the left hand end of the cartridge assembly. This disposition of these elements insures correct relation of the cartridge construction to the external construction especially as to the passage from the interior of the cartridge through the housing and the lateral connection 14. Also the cartridge construction cannot possibly be locked by the element 88 in its operative position until the projection 46' is properly seated within its co-acting notch.

After the insertion of the cartridge construction as described above, the element 88 is turned until its outermost portion is seated within the crescent shaped slot 90 within the head 92. The element 88 is held in this position while the nut 87 is tightened against 88 to secure it in its locking relationship. Thereupon, the entire pressure sealing assembly including the elements 104, 108, 102, 110, 112, is moved into operative position by sliding the projections 120, 122 through the co-operating axial slots in the right hand end of the head 92. The member 104 is then turned so that the projections 120, 122 will become seated against the shoulders 128, 130 upon the turning of the nut 110 upon the stem 102. This action also causes the gasket construction 106 to complete the pressure seal, in the manner described above.

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of my invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a tubular fluid flow resistor normally disposed in a fluid circuit, a resistor housing, a readily removable tubular cartridge construction having a slidable fit within said housing, a plurality of separately replaceable fluid flow resistance elements disposed in flow succession and slidably fitted within said cartridge with all of the resistance elements normally simultaneously subject to the fluid flow of said circuit, means associated with the housing for normally maintaining said cartridge in its operative position relative to said circuit, and a pressure sealing device having closure mechanism to afford a pressure seal for an access opening in the housing and providing for the ready removal of said cartridge for adjustment of its flow resistance capacity by the addition or subtraction of a flow resistance element.

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2. In a fluid flow resistor, a tubular resistor housing, a tubular cartridge construction having a slidable fit within said housing, a plurality of separately replaceable orifice plate constructions slidably and replaceably fitted in flow succession within said cartridge cylinder, means for holding said cartridge cylinder with all of its resistance elements in operative position within the resistor housing and within a fluid line with all of said orifice plate constructions normally simultaneously subject to the main fluid flow through the cartridge construction, a closure head rigidly associated with the resistor housing, and pressure sealing devices within the closure head for normally permitting the resistor to work in a fluid line under high fluid pressure while at the same time affording access to the resistor housing for the removal of said cartridge cylinder to change the number of its orifice plates or fluid resistance elements.

3. In a flow resistor adapted to present predetermined different resistances in a fluid flow line, a resistor assembly including a tubular housing and a pressure sealing head therefor, a removable tubular cartridge cylinder having a sliding fit within the housing, a plurality of separately replaceable orifice unit constructions mounted slidably fitted in succession within said cylinder, means locking the cartridge cylinder within the housing and preventing longitudinal movement relative thereto, and a pressure sealing construction associated with said head and sealing an opening through which said cartridge cylinder is accessible for the removal or addition of one or more orifice unit constructions, all of said orifice unit constructions being normally subject to substantially all of the fluid flow through said line.

4. In a flow resistor adapted to present predetermined different resistances in a fluid flow line, a resistor assembly including a tubular housing and a pressure sealing head therefor, a removable tubular cartridge cylinder slidably fitted within the housing, a plurality of separately removable and interlocked orifice unit constructions mounted in succession within said cylinder, means locking the cartridge cylinder within the housing and preventing longitudinal movement relative thereto, successive orifice units forming orifice plates with orifices which are offset radially and circumferentially of said cylinder, and a pressure sealing construction associated with said head and sealing an opening through which said cartridge cylinder is accessible for removal or addition of one or more of the orifice unit constructions, all of said orifice units being normally subject to substantially all of the fluid flow through said line.

5. In a flow resistor adapted to present predetermined different resistances in a fluid flow line, a resistor assembly including a tubular housing and a pressure sealing head, the housing having a fluid inlet and a fluid outlet arranged in series in the flow line, a removable tubular cartridge cylinder within the housing, a plurality of separately removable and interlocked orifice units slidably fitted within said cylinder, means locking the cartridge cylinder within the housing and preventing longitudinal movement relative thereto, and a pressure sealing construction associated with said head and sealing an opening through which said cartridge cylinder is accessible for the removal or addition of one or more of the orifice unit constructions.

6. In a flow resistor adapted to present pre-

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determined different resistances in a fluid flow line, a resistor assembly including a tubular housing and a pressure sealing head therefor, a removable tubular cartridge cylinder slidably fitting within the housing and interlocked in operative relationship therewith, a plurality of interlocked orifice units slidably and separately removably fitted within said cylinder, the successive orifice units having orifices which are alternately disposed on opposite sides of the axis of the cartridge, means locking the cartridge cylinder within the housing and preventing longitudinal movement relative thereto, and a pressure sealing construction associated with said head and sealing an opening through which said cartridge cylinder is accessible for the removal or addition of one or more of the orifice unit constructions.

7. In a flow resistor adapted to present predetermined different resistances in a fluid flow line, a resistor assembly including a tubular housing and a pressure sealing head therefor, a removable tubular cartridge cylinder slidably fitted within the housing, a plurality of separately removable and interlocked orifice unit constructions mounted in succession within said cylinder, said orifice constructions being cup-shaped means for locking said orifice units and the cylinder in predetermined circumferential positions wherein the orifices of successive units are angularly displaced of the cylinder, means locking the cartridge cylinder within the housing and normally preventing longitudinal movement relative thereto, and a pressure sealing construction associated with said head and sealing an opening through which said cartridge cylinder is accessible for removal or addition of one or more orifice unit constructions, all of said orifice units being normally subject to substantially all of the main fluid flow through said line.

8. In a multiple orifice flow resistor assembly for a fluid flow line, a tubular part of the fluid flow line constituting a resistor housing, a removable inner cylinder or cartridge construction having a sliding fit within said housing and provided with a fluid inlet and a fluid outlet normally in series in said flow line, the assembly being formed with a lateral access opening through which the cartridge can be inserted in or removed from the housing without interruption of the flow line, slidably inter-engaging means on the cartridge and the housing for insuring the correct operative flow line disposition of the cartridge in the housing, separately removable orifice plate constructions normally interlocked within the cartridge in predetermined circumferential relationships, means including spacing rings for holding the orifice plates therein, means for locking the cartridge in operative position within the housing, and readily removable pressure sealing means affording a pressure tight closure for the access opening.

9. In a multiple orifice flow resistor assembly for a fluid flow line, a tubular part of the fluid flow line constituting a cylindrical resistor housing, a removable inner cylinder or cartridge construction having a sliding fit within said housing and provided with a fluid inlet and a fluid outlet normally in series in said flow line, the assembly being formed with a lateral access opening through which the cartridge can be inserted in or removed from the housing without interruption of the flow line, separately removable orifice plate constructions normally interlocked within the cartridge in predetermined angularly displaced relationships, means for locking the cartridge in

operative position within the housing, and readily removable pressure sealing means affording a pressure tight closure for the access opening, all of said orifice plate constructions being normally subject to all of the fluid flow through said line.

10. In a multiple orifice flow resistor for a fluid flow line, a tubular part of the flow line constituting an elongated tubular housing having an axial inlet and a lateral outlet and a plurality of separately removable and similarly constructed orifice plate constructions mounted successively within the housing, each of said orifice plates being cup-shaped and having a hollow cylindrical rim with a connecting transverse web or disk, the webs or disks of successive orifice plates having orifices disposed oppositely eccentrically relative to the

center line of the housing, each of said orifice plate constructions also having a projection and recesses of corresponding dimensions formed along the axially opposite edges of its rim.

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