March 5, 1963 M. L. FREUDENTHAL ET AL 3,079,796

ORIFICE PLATE TRANSFER APPARATUS

Filed Feb. 4, 1960 3 Sheets-Sheet 1

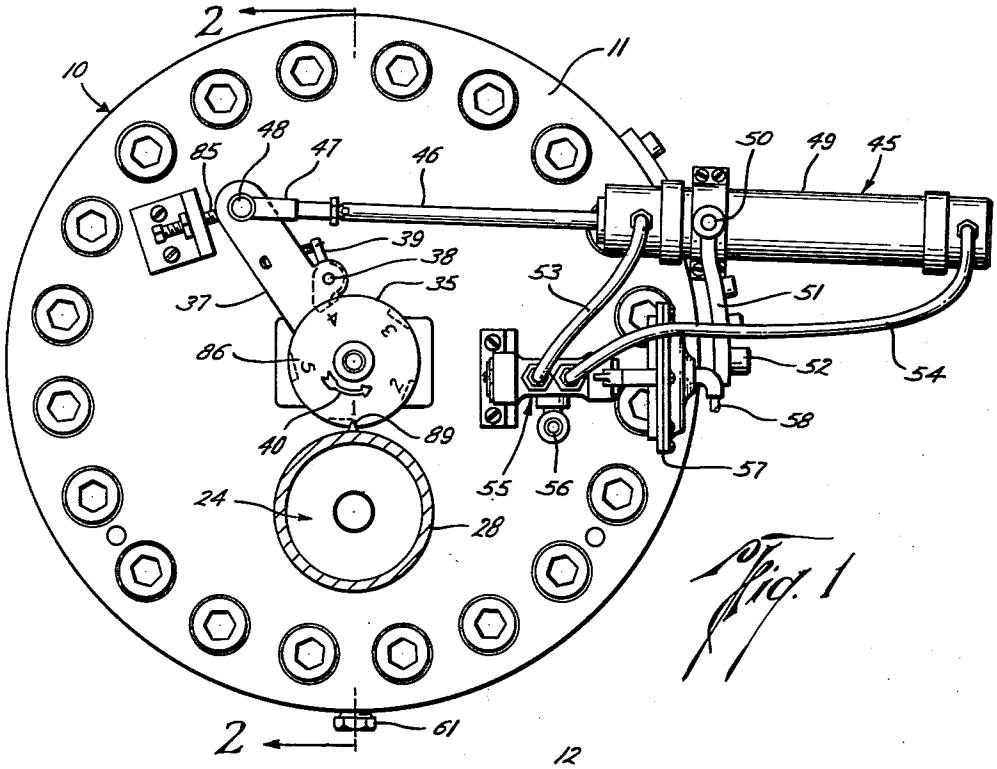


Fig. 1

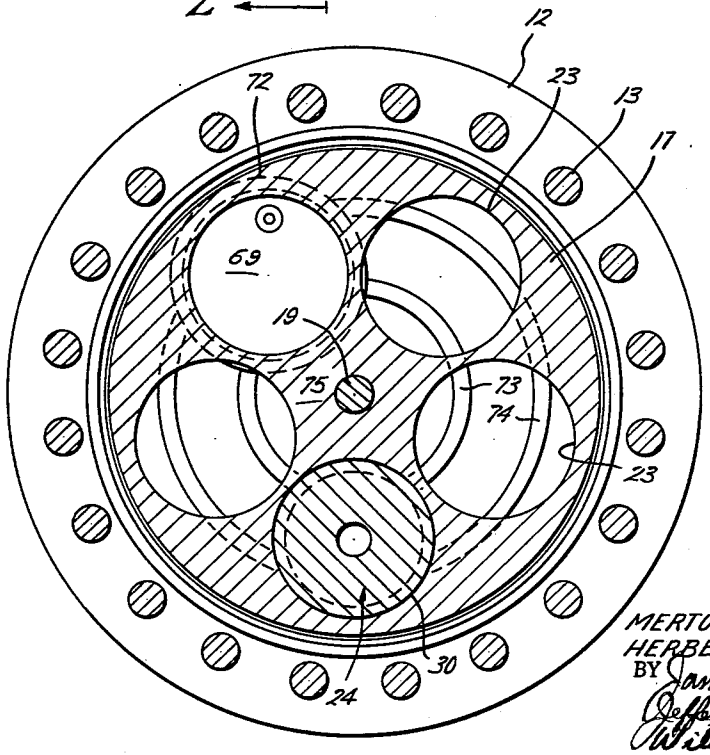


Fig. 3

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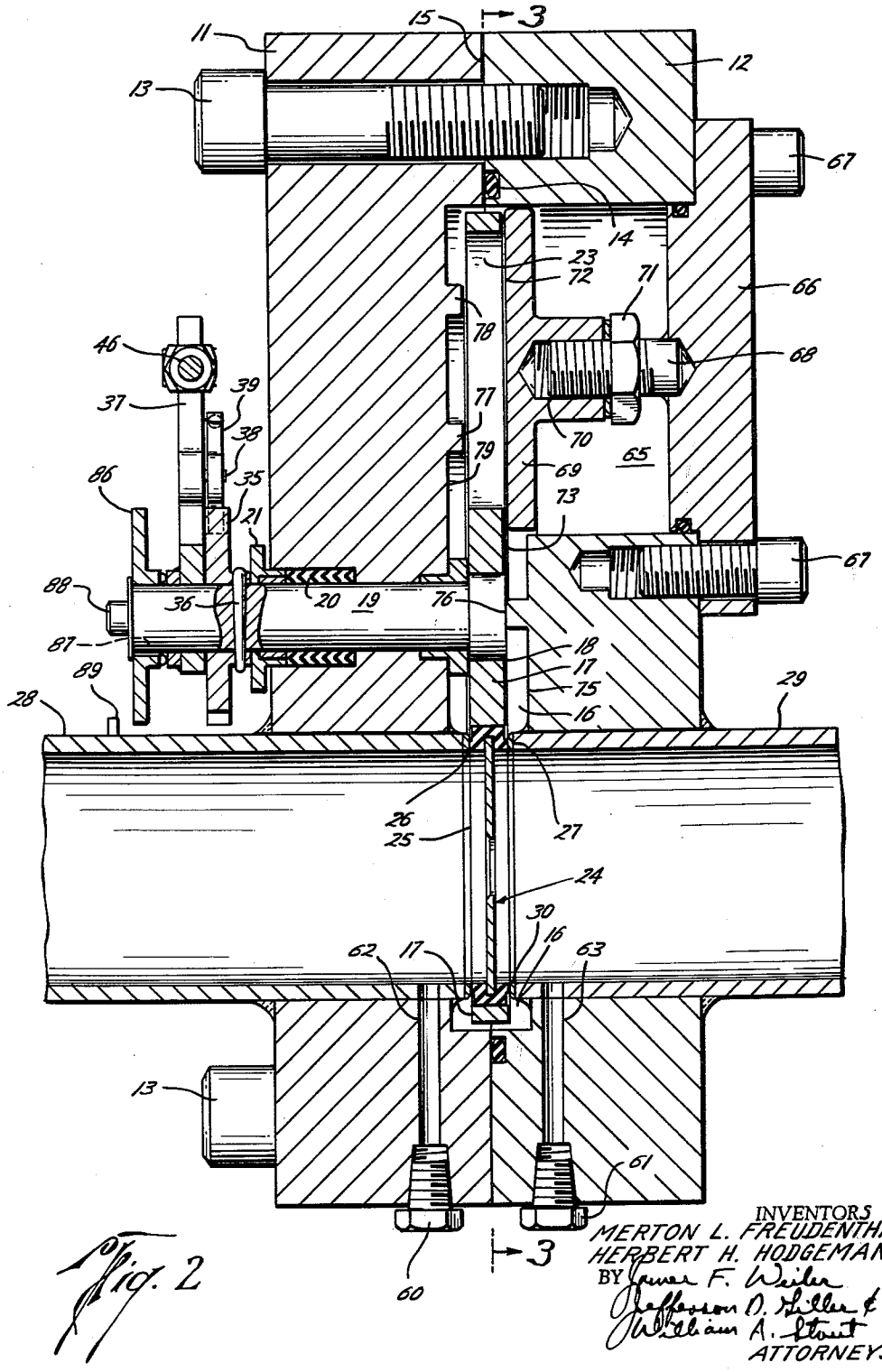


Fig. 2

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Fig. 4

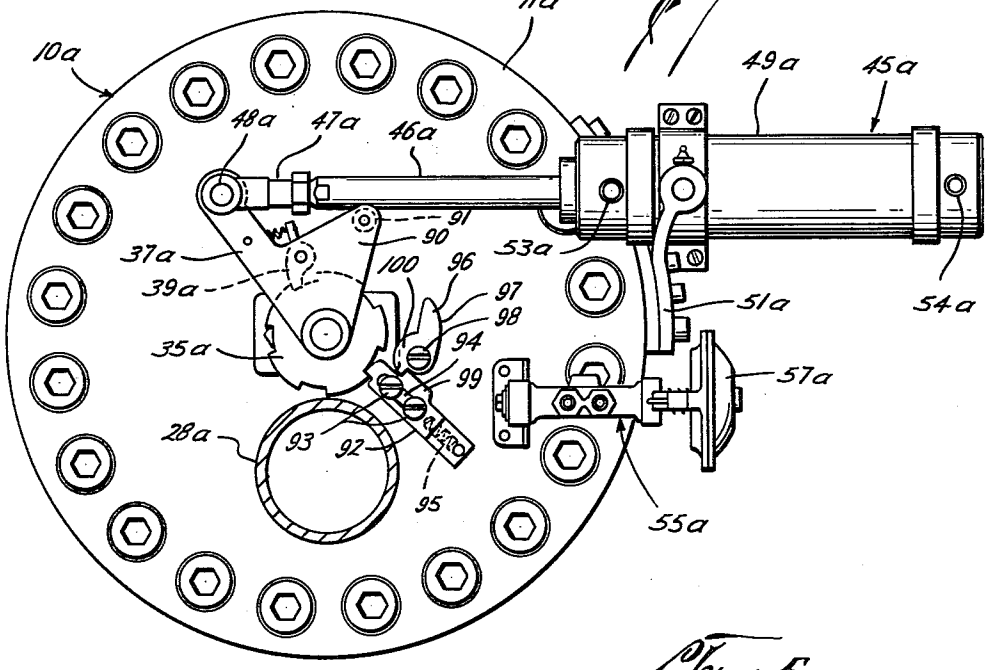
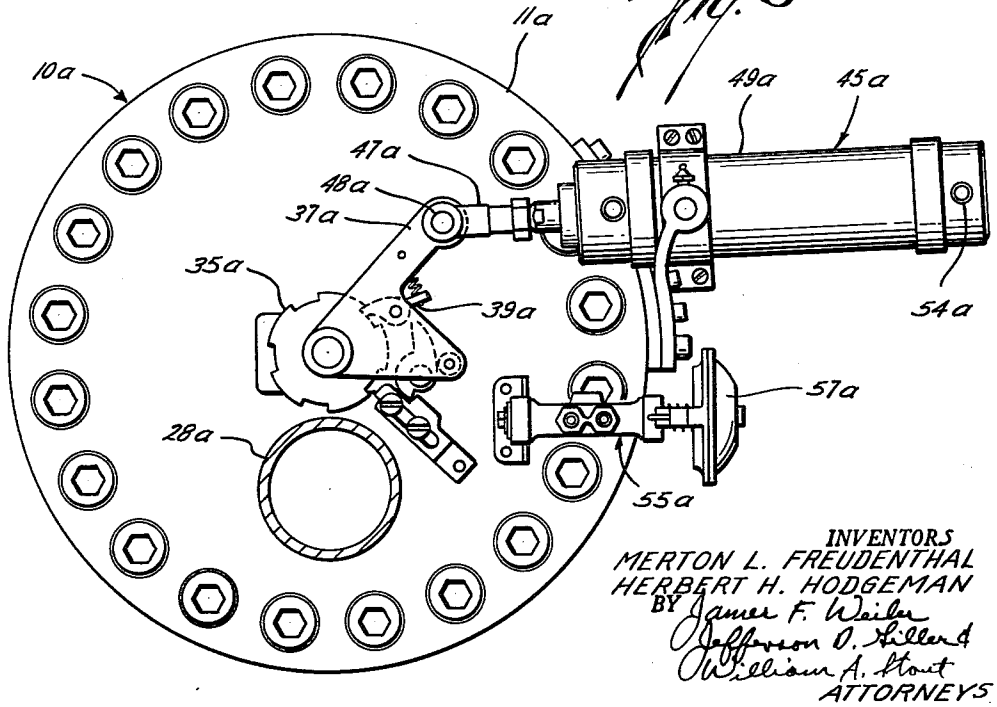


Fig. 5



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ORIFICE PLATE TRANSFER APPARATUS

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This invention relates to flow measuring apparatus wherein pressures are measured upstream and downstream from an orifice plate assembly to determine the rate of flow of fluid. This invention is particularly directed to improved forms of orifice plate transfer assemblies which enable any one of a series of orifice plate assemblies to be brought into flow-measuring position.

While various orifice plate transfer assemblies have been proposed and used in the art, they have not been and are not entirely satisfactory for several reasons. Difficulties have been encountered in properly aligning the orifice in the pipe by the transfer mechanism. It has been necessary to bleed down the line when changing plates. Previous orifice plate transfer assemblies do not readily lend themselves to remote control operation which has become and is becoming more and more important as automation is applied in the art. Moreover, many, if not all, orifice plate transfer assemblies proposed and used in the art are not entirely satisfactory for high pressure use, which high pressures are becoming more and more prevalent in the art. The present invention is directed to an improved orifice plate transfer assembly which in its several aspects overcomes the previously-mentioned disadvantages of such orifice plate transfer assemblies.

It is therefore an object of the present invention to provide an improved orifice plate transfer mechanism which overcomes the above-mentioned disadvantages.

A further object of the present invention is the provision of an orifice plate transfer mechanism which includes positive stop means which insure accurate alignment of the orifice plate in the line.

Still a further object of the present invention is the provision of an orifice plate transfer assembly by which orifice plates may readily be changed or removed and repaired or replaced without bleeding down the line.

A further object of the present invention is the provision of an orifice plate transfer mechanism which may conveniently be operated from a remote location and which can readily be incorporated into and be operated by automation systems.

Still a further object of the present invention is the provision of an orifice plate transfer mechanism which is readily and effectively used in high pressure systems.

A further object of the present invention is to provide an improved form of orifice plate transfer mechanism which employs a rotary carrier plate having a plurality of openings each carrying an orifice plate assembly in which the rotary plate carrier is positioned within a chamber, and wherein ribs are provided on the walls forming the chamber for sliding contact with the orifice plate assemblies carried by the plate carrier.

Another object is to provide such a device in which the chamber is defined between two body members, one of the body members having a rotary shaft extending therethrough for turning the plate carrier, and the other body member having an access opening for installation and removal of orifice plate assemblies with respect to the plate carrier, the access opening having a removable closure.

Other and further objects and advantages will appear from the following description of presently-preferred embodiments of the invention, given for the purpose of disclosure, and taken in conjunction with the accompanying drawings, where like references designate like parts throughout the several views, and where

FIGURE 1 is a front elevation showing an orifice transfer plate according to the invention.

FIGURE 2 is a sectional elevation taken on the lines 2—2 as shown in FIGURE 1,

FIGURE 3 is a sectional view partly broken away taken on the lines 3—3 as shown in FIGURE 2,

FIGURE 4 is a front elevation similar to that of FIGURE 1 illustrating a modification of the invention, and

FIGURE 5 is a front elevation similar to that of FIGURE 4 illustrating the device in a positive-stopped position insuring accurate alignment of the orifice plate in the line.

Referring to the drawings, and particularly to FIGURES 1–3, inclusive, the body or housing generally designated 10 is formed of two housing members 11 and 12, as best seen in FIGURE 2, which are circular in shape and which are clamped together by means of threaded fastenings 13. A seal ring 14 at the joint face 15 prevents leakage. As best seen in FIGURE 3 the body members 11 and 12 cooperate to form a circular chamber 16 therebetween and a circular plate carrier 17 is mounted to rotate within this chamber 16. As best seen in FIGURE 2 plate carrier 17 is fixed by welding or brazing 18 or otherwise connected to the rotary shaft 19 projecting axially through the body member 11. The seal rings 20 and a gland 21 encircle the rotary shaft 19 and serve to prevent leakage.

Referring now to FIGURE 3, the plate carrier 17 is provided with a plurality of openings 23 extending therethrough which are circumferentially spaced in the carrier plate 17 and which are equidistant from the rotation axis of the shaft 19. Each of these openings is adapted to receive an orifice plate assembly 24 and these orifice plate assemblies 24 may be of the type disclosed in the Whalen Patent 2,687,748 or the Whalen Patent 2,860,901, or may be of conventional construction so long as they are able to fit within and seal the gap 25 between adjacent ends 26 and 27 of the aligned pipes 28 and 29 as shown in FIGURE 2. The adjacent pipe ends 26 and 27 may be provided with wear rings 30 if desired. Each of the aligned pipes 28 and 29 projects through its respective body member and projects into the circular chamber 16. Each pipe is preferably welded to its respective body member.

Means are provided for turning the plate carrier 17 within the circular chamber 16, and referring now to FIGURE 2, this means includes a ratchet wheel 35 fixed on the projecting end of the shaft 19 exteriorly of the chamber 16. The ratchet wheel 35 may be connected to the shaft 19 by means of the taper pin 36. As shown in both FIGURES 1 and 2, a crank arm 37 is loosely mounted on the shaft 19 adjacent to the ratchet wheel 35. This arm 37 carries a pivot pin 38 which supports a spring loaded or actuated pawl 39. This pawl provides a one-way drive for turning the shaft 19 in the direction of the arrow 40 as shown in FIGURE 1. When the arm 37 moves in a counterclockwise direction, the pawl 39 engages the teeth on the periphery of the ratchet wheel 35 to turn the shaft 19 and the plate carrier 17. When the arm 37 moves in a clockwise direction, as viewed in FIGURE 1, the pawl 39 rotates about the pin 38 against the tension of the spring but does not turn the ratchet wheel 35. A suitable stop means 85 may be provided adjacent the crank arm 37 to limit its movement in a counterclockwise direction to insure that the plate carrier 17 is rotated in equally spaced increments.

Referring again to FIGURE 1, suitable means are provided to move the arm 37, here shown as a power cylin-

der assembly generally designated by the reference numeral 45. This assembly 45 includes a piston rod 46 which is connected to the arm 37 by means of the clevis 47 and the pivot pin 48. The cylinder 49 is supported on the pivot pins 50 carried on a yoke 51 fixed to the body member 11 by means of the threaded fastenings 52. The flexible hose connections 53 and 54 are connected to opposite ends of the cylinder 49 for driving the piston (not shown) in either direction for reciprocating the piston rod 46. The hoses 53 and 54 are connected to a four-way valve assembly 55 mounted on the body member 11. Gas under pressure for actuating the power cylinder 45 is supplied to the four-way valve assembly 55 through the connection 56, and control pressure for operating the four-way valve assembly 55 is supplied to the diaphragm member 57 by means of the conduit 58. Additional conduits, not shown, are connected to the fittings 60 and 61, as shown in FIGURE 2, on the body members 11 and 12, respectively. The fitting 60 communicates by way of passageway 62 with the interior of the pipe 28 on one side of the orifice plate assembly 24, and the fitting 61 communicates by way of passage 63 with the interior of the pipe 29 on the other side of the orifice plate assembly 24.

No more details of the power assembly 45 are given as any preferred actuating assembly for the arm 37 may be used whether it is pneumatic, hydraulic, mechanical, electrical or a combination thereof.

As shown in FIGURE 2 an access opening 65 is provided in the body member 12 for installing and removing orifice plate assemblies from the openings 23 in the plate carrier 17. As previously mentioned each of the openings 23 may be filled with an orifice plate assembly, although certain of these are omitted from the drawings for clarity of illustration. The access opening 65 is closed by a removable closure 66 held in place by the threaded fastening 67 which closure 66 carries a central stationary post 68. A back-up plate 69 is provided with a central threaded socket 70 which receives the threaded post 68. A jam nut 71 holds the back-up plate 69 in adjusted position with its forward face 72 in a co-planar position with concentric arcuate ribs 73 and 74 (FIGURE 3) which project into the chamber 16 from the wall 75 of the body member 12. A boss 76 on the wall 75 engages the center portion of the end of the shaft 19. Concentric arcuate ribs 77 and 78 project from the wall 79 of the body member 11 into the chamber 16. The ribs 73 and 74 are interruped by the access opening 65 and by the inward projecting end of the pipe 29. The ribs 77 and 78 on the body member 11 are each circular except for the portion which is interrupted by the inwardly projecting end 26 of the pipe 28.

The concentric ribs 73 and 74 and the concentric ribs 77 and 78 serve as guides which contact the side edges of the orifice plate assemblies 24 which are in positions other than between the adjacent ends of the pipes 28 and 29. The orifice plate assemblies 24 are not tightly held within their respective openings 23 in the plate carrier 17, in order that they may seal properly in the gap between the adjacent pipe ends. The concentric ribs described above hold the inactive orifice plate assemblies in central position and the ribs minimize friction between the orifice plate assemblies and the body members when the plate carrier 17 is turned.

In operation, fluid passes through the aligned pipes 28 and 29 and the pressure drop across the orifice plate assembly 24 is measured by means of pressures in conduits attached to the terminal fittings 60 and 61. When it is desired to move another orifice plate assembly into position in order to obtain a different size opening or for any other reason, pressure is supplied through conduit 58. This causes the four-way valve 55 to actuate the power cylinder 45 through flexible hoses 53 and 54. The arm 37 swings clockwise away from the adjustable stop 85 while the pawl 39 rotates about the pivot pin 38. Release of pressure in the line 58 then causes the diaphragm mechanism 57 to again shift the internal parts of the four-way valve assembly 55 and cause the power cylinder assembly 45 to extend the piston rod 46, thereby swinging the arm 37 in a counterclockwise direction. The pawl 39 then engages the notched periphery of the ratchet wheel 35 and turns the shaft 19 and the plate carrier 17 in the direction of the arrow 40. This arrow 40 is cast or otherwise mounted on an indicator plate 86 which is fixed to the shaft 19 by means of key 87 and threaded fastener 88. A stationary index pointer 89 attached to the outer surface of the pipe 28 provides a reference point indicating which of the various orifice plate assemblies is in operative position, as shown by the numbers or other indicia on the indicator plate 86.

Advantageously the orifice plate assemblies 24 may be installed and removed with respect to the plate carrier 17 by removal of the closure 66 and back-up plate 69 without bleeding down the line as here shown by the aligned pipes 28 and 29. This is accomplished because the orifice plate assemblies 24 seal the pressure in the line when in place and equalize the pressure in the line and in the chamber 16 while moving the plate-like carrier 17. With an orifice plate assembly 24 in place in the line, the pressure may be bled out of the chamber 16 by slightly loosening the closure plate 66. Once the pressure in chamber 16 has been equalized with atmospheric pressure, the closure plate 66 may then be removed, the orifice plate assembly 24 removed for repair or replacement and another installed. The closure plate 66 may then be secured to the access opening 65 and when an orifice plate assembly 24 is moved from the gap 25 between the aligned pipes 28 and 29 the pressure in the chamber 16 will automatically be equalized with the line pressure.

As previously mentioned, it is advantageous to provide a positive stop so that the orifice plate assembly 24 will be accurately positioned in the gap 25, FIGURE 2, between the aligned ends 26 and 27 of the pipes 28 and 29. Such a construction is illustrated in FIGURES 4 and 5, to which reference is now made, and in which the reference letter "*a*" is added to parts corresponding to those of FIGURES 1–3, inclusive.

As shown in FIGURES 4 and 5, the arm 37*a* is provided with the generally rearwardly-extending projection 90 which carries a roller 91 at its outer terminal end. A stop member 92 is slidably secured to the housing member 11*a* by the bolts 93 disposed in the slot 94. The spring 95 urges the stop 92 into engagement with the notches in the ratchet wheel 35*a*, as shown in FIGURE 4.

A cam 96 provided with the cam surface 97 is pivotally connected to the housing by the cam screw 98 for actuation of the stop member 92 when the roller 91 engages and rolls along the cam surface 97. To this end, an enlargement 99 is provided on the stop member 92 which is engaged by the ear 100 on the cam 96 so that actuation of the cam 96 by the roller 91 urges the stop member 92 away from and out of engagement with the notches in the ratchet wheel 35*a* as shown in FIGURE 5.

In operation, when the power cylinder 45*a* is actuated to move the piston rod 46*a* inwardly into the cylinder 49*a*, as previously described, the roller 91 toward the end of the stroke engages the cam surface 97 and moves the cam 96 thereby forcing the stop member 92 out of engagement with the notches in the ratchet wheel 35*a* as shown in FIGURE 5. This frees the ratchet wheel 35*a* for movement by the pawl 39*a* on the return stroke, the inner end of the stop member 92 sliding along the outer surface of the ratchet wheel 35*a* during the return stroke of piston rod 46*a*. At the completion of this stroke, the stop member 92 engages the notch in the ratchet 35*a* moved proximate its end and thereby provides a positive stop, as shown in FIGURE 4, which thereby insures that the orifice plate assemblies 24, not shown in these views, will be properly aligned as previously mentioned. It is noted that the ratchet wheel 35*a*, and hence the

orifice plate assemblies 24, are locked by engagement in either direction.

The other parts and operation of the orifice plate transfer device 10*a* shown in FIGURES 4 and 5 are the same as those in FIGURES 1–3, inclusive, previously mentioned. Accordingly, no more detailed description thereof is deemed necessary.

While the power cylinder assemblies 45 and 45*a* shown in FIGURES 1 and 4–5 are highly advantageous in use, if desired manual means may be utilized in addition thereto to rotate the plate 17 in the event of a power failure or may be substituted therefor to provide a completely manual system.

The present invention, therefore, is well suited and adapted to obtain the advantages and carry out the objects and ends mentioned as well as others inherent therein.

While presently-preferred embodiments of the invention have been given for the purpose of disclosure, changes in details of construction and arrangement of parts will occur to those skilled in the art which are encompassed within the spirit of the invention as defined by the scope of the appended claims.

What is claimed is:

1. In a flow measuring orifice plate transfer device, the combination of: a pair of body members having walls cooperating to define a generally circular chamber therebetween, a plate carrier in the chamber, means including a rotary shaft projected through a wall of one of the body members for supporting and turning the plate carrier about the shaft axis, said plate carrier having a plurality of circumferentially-spaced openings for reception in each of said openings of an orifice plate assembly, each body member having a pipe extending therethrough with an end projecting into said chamber at a location offset from the shaft axis, the pipes being axially aligned and having a gap between adjacent ends, the plate carrier extending into said gap to position one of the orifice plate assemblies between the pipe ends, and means positioned exteriorly of the chamber for turning the shaft by increments to bring any one of the orifice plate assemblies into alignment with the pipe ends, said last-mentioned means including a ratchet wheel connected to the shaft, an arm rotatably mounted on the shaft adjacent the ratchet wheel, a pawl carried by the arm and effectively engaging the ratchet wheel in one direction for rotating the ratchet wheel in said one direction only, a spring-pressed stop member yieldingly urged against the ratchet wheel providing a positive stop thereof, a cam adjacent the stop member, means on the cam engaging the stop member for moving the stop member away from and out of engagement with the ratchet wheel upon actuation of the cam, a cam roller secured to the arm and arranged to engage the cam upon movement of the arm in a direction away from said one direction thereby freeing the ratchet wheel for rotation by the pawl of the ratchet wheel on movement of the arm in said one direction, and means for moving the arm.

2. In a flow measuring orifice plate transfer device, the combination of: first and second body members having walls cooperating to define a generally circular chamber therebetween, a plate carrier in the chamber, means including a rotary shaft projecting through a wall of the first body member and fixed to the plate carrier for supporting and turning the plate carrier within the chamber, said plate carrier having a plurality of circumferentially-spaced openings therein equidistant from its axis arranged to slidably receive an orifice plate assembly therein, each body member having a pipe extending therethrough with an end projecting into said chamber at a location offset from the shaft axis, the pipes being axially aligned and having a gap between adjacent ends, the plate carrier extending into said gap to position one of the orifice plate assemblies between the pipe ends, at least one guide holder on each body member projecting into the chamber for sliding contact with the other of said orifice plate assemblies for holding said assemblies in said openings, means on the first body member for turning the shaft by equal increments to bring any one of the orifice plate assemblies into the gap and into alignment with the pipe ends, said last mentioned means including a rachet wheel connected to the shaft, a crank arm loosely mounted on said shaft, a spring loaded pawl carried by the crank arm and engaging the rachet wheel for one way drive, sealing means disposed about each orifice plate assembly and sized to contact the pipe ends for sealing off pressure in the pipe ends from the chamber when the orifice plate is disposed in the gap, means on the other body member providing an access opening for installation and removal of orifice plate assemblies with respect to the plate carrier, a removable closure for said access opening, and stop means arranged to engage the means on said first body member for turning the shaft upon bringing each of said openings in said plate carrier into the gap and into alignment with the pipe ends.

3. In a flow measuring orifice plate transfer device, the combination of: a pair of body members having walls, cooperating to define a generally circular chamber therebetween, a plate carrier in the chamber, means including a rotary shaft projecting through a wall of one of the body members for supporting and turning the plate carrier about the shaft axis, said plate carrier having a plurality of circumferentially-spaced openings therein, each opening having an orifice plate assembly slidably mounted therein, each body member having a pipe extending therethrough with an end projecting into said chamber at a location offset from the shaft axis, the pipes being axially aligned and having a gap between adjacent ends, the plate carrier extending into said gap to position one of the orifice plate assemblies between the pipe ends, each of said body members having a passageway on opposite sides of the gap and extending into one of the pipes for measuring the pressure on either side of an orifice, arcuate holding ribs on each of said body members projecting into the chamber for sliding contact with both sides of the other orifice plate assembly for holding said other orifice plate assemblies in said openings, and means positioned exteriorly of the chamber for turning the shaft by equally spaced increments to bring any one of the orifice plate assemblies into alignment with the pipe ends, said last mentioned means including a rachet wheel connected to the shaft, a crank arm rotatably mounted on the shaft adjacent the rachet wheel, a pawl carried by the arm and effectively engaging the rachet wheel in one direction only, a spring-pressed stop member yieldably urged against the rachet wheel providing a positive stop thereof, a cam adjacent the stop member, means on the cam engaging the stop member for moving the stop member away from and out of engagement with the rachet wheel upon actuation of the cam, a cam roller secured to the crank arm and arranged to engage the cam upon movement of the arm in a direction away from said one direction thereby freeing the rachet wheel for rotation by the pawl of the rachet wheel on movement on the arm in said one direction, and double acting arm moving means connected to said crank arm for actuation of the arm in both directions.

4. In a flow measuring orifice plate transfer device, the combination of: first and second body members having walls cooperating to define a generally circular chamber therebetween, a circular plate carrier in the chamber, means including a rotary shaft projecting through a wall of the first body member and fixed to the plate carrier for supporting and turning the plate carrier within the chamber, said plate carrier having a plurality of circumferentially-spaced openings therein equidistance from its axis arranged to slidably receive an orifice plate assembly therein, each body member having a pipe ex-

tending therethrough with an end projecting into said chamber at a location offset from the shaft axis, the pipes being axially aligned and having a gap between adjacent ends, the plate carrier extending into said gap to position one of the orifice plate assemblies between the pipe ends, an annular U-shaped seal disposed about the periphery of each orifice plate and within the carrier opening and sized to contact the pipe ends and seal off pressure between the pipe ends from the chamber when an orifice plate is disposed in the gap, at least one arcuate guide holder on each body member projecting into the chamber for sliding contact with all of the other of said orifice plate assemblies for holding said assemblies in said carrier openings, means on the first body for turning the shaft by equal increments to bring any one of the orifice plate assemblies into the gap and into alignment with the pipe ends, means on the other body member providing an access opening for installation and

removal of orifice plate assemblies with respect to the plate carrier, a removal closure for said access opening, and stop means arranged to engage the means on said first body member for turning the shaft upon bringing of each of said opening in said plate carrier into the tap and into alignment with pipe ends.

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