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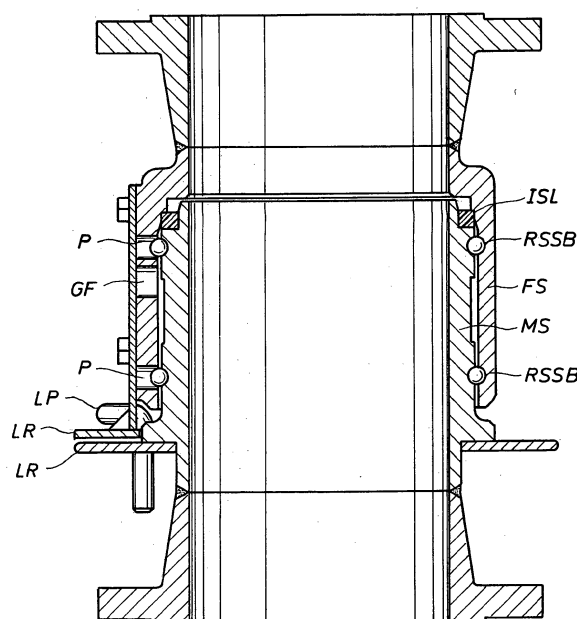
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This application was filed on 26-04-2021 as a divisional application to the application mentioned under INID code 62.

(54) **SWIVEL DEVICE FOR HYDRANTS**

(57) A swivel device for an at least 6 inch hydrant manifold for industrial fire fighting, comprising a first fitting structured to fixedly attach, directly or indirectly, to a hydrant manifold inlet valve or riser pipe, a swivel body (SW, FS) structured for sealing, rotational attachment, directly or indirectly, to the first fitting and providing a second fitting structured to fixedly attach, directly or indirectly, to a hydrant manifold and a locking device (LR, LP) structured to fix a rotatable attachment position between the swivel body and the first fitting. The first fitting and the swivel body provide an at least 6 inch fluid conduit between the first fitting and the second fitting.

FIG.7



Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is related to, and claims priority from, co-pending Applications Serial No. 61/459,232 and Serial No. 61/464,628, filed 12/9/2010 and 3/7/2011 respectively by the same inventors, and entitled Swivel Hydrant Manifold for Industrial Fire Fighting and Swivel With or for Industrial Hydrant Manifold for Industrial Fire Fighting, respectively. The content of both said provisional applications is herein and hereby incorporated by reference.

FIELD OF THE INVENTION

[0002] The invention relates to hydrant manifolds for industrial fire fighting at plants and facilities, and in particular to a swiveled hydrant manifold. ("Manifold", as used herein, can include a single port.)

BACKGROUND OF THE INVENTION

[0003] Fire field logistics present problems that rank nearly as high as equipment-on-hand problems and personnel-available problems when facing an industrial fire fighting response.

[0004] Large fires require large volumes of water which sometimes require multiple large diameter water supply hoses, of 6 inch diameter and larger. The most convenient, reliable, and safest means of distributing large volumes of water over an entire facility is through constructing underground water delivery systems with above-ground hydrant manifolds. These hydrant manifolds are used in conjunction with large diameter water supply hose to supply the necessary water to pumps, fire fighting nozzles and foam proportioning equipment.

[0005] In current practice hydrant manifolds are fixed in regard to the direction they face. Hose that must ultimately run in the opposite direction, thus, must be laid in a large diameter circle in order to effect a 180° turn of the direction of the water without sacrificing head pressure. A 12 inch diameter hose may require a 50 foot turning ratio. The extra hose required to alter the direction of water 180° might be several hundred feet. Large diameter hose is expensive. The cost might run about \$2,500 for a 12 inch hose. For that reason sometimes hydrant manifolds are placed on both sides of the road, facing in opposite directions, to address this problem. However, a duplication of iron and of header equipment is then required.

[0006] The use of a swivel, with or for a hydrant manifold, can save the cost of providing manifolds on both of sides of a road in order to have a manifold facing in the right direction, and/or can save the cost and expense of carrying and laying extra hose. Since in recent years the size of headers and thus the size of hose and the cost of hose has risen dramatically, the industry is looking for

ways to minimize cost and maintenance in regard to fire fighting systems.

[0007] Swivels capable of managing thousands of pounds of thrust associated with large fire fighting monitors have been available since the late 1980's, but only from limited suppliers. Williams believes they were the first to provide such large scale swivels, 6 inch and larger, for monitors. Williams has extensively tested in-house swivels for monitors capable of operating after months and years of sitting in the weather as well as capable of handling thousands of pounds of thrust from monitors. Williams is in possession of extensive in-house testing in regard to the weathering and force handling properties of swivels.

[0008] Although the industrial fire fighting industry has historically tolerated the waste of hose and duplication of hydrants associated with fixed hydrant manifolds, with the increased diameter requirements for the supply pipes and hoses, the cost of the waste has risen. The inventors view this situation as a problem. With Williams testing experience, the instant inventors teach that an adequate swivel can be provided for use with, or for, a hydrant manifold, to solve this problem.

[0009] The invention involves appreciating that the long tolerated situation constitutes an unnecessary problem, a waste of hose and logistics complications associated with fixed hydrant manifolds. The invention further involves knowledge of the testing of swivels, large diameter swivels, which testing indicates that a swivel can be provided for fixed hydrant manifolds that will meet the requirements of enduring the necessary thrust and weathering, for the long term.

[0010] The instant invention, therefore, comprises a line of swivels for use with, or for, hydrant manifolds, preferably having an incorporated 360° rotating capability. The swivel is structured for location below a manifold and typically above a valve associated with a water delivery system, or a riser pipe. Such a swivel, tested to endure the requisite ranges of thrust and weather, can allow first responders to position a hydrant in a most advantageous direction depending on the location of the hazard, and preferably to lock the swivel into place using a convenient onboard swivel position lock. A swiveled hydrant manifold saves the cost of providing multiple manifolds facing different directions and/or of providing a hundred or more extra feet of hose required to redirect water without undue pressure loss.

Design Benefits for a Swivel, with or for a Hydrant Manifold:

- reduction in total hose required due to eliminating initial bend radius;
- reduction in road blockage due to initial hose bends running across roadways;
- conservation of pressure due to shorter hoses needed;
- suitable for highly congested areas (vertical de-

- sign);
- suitable for a wide range of flows, up to 12,000 gpm;
- built with an industrial fire fighter in mind;
- robust design using swivels capable of supporting several tons of side load;
- fully serviceable with integrated swivel grease zerks;
- by more efficiently supplying water, swivel hydrants can reduce the number of necessary hydrant locations by as much as 50% (depending on hydrant layout and size).

Preferred Design Choices Include:

- various material designs and various inlet and riser sizes (e.g. 4", 6", 8", 10" 12");
- various header designs (vertical stack, traditional Tee, or single 90° outlet);
- various discharge options (NST, BSP, Storz, etc.);
- various discharge sizes (1-1/2"-12");
- integrated swivel lock to prevent movement after positioning;
- available with discharge valves, check valves, caps, or pressure gauges;
- available with integrated monitor mount;
- available with integrated automatic hydrant drain valve (below swivel);
- available with hydrant inlet valve (between hydrant swivel and header connection).

Sizing Guide

- The below figures are based on a 24" underground header with 8' of vertical piping extending to base of the hydrant. Loss numbers are from underground header inlet point to hydrant discharge (hose connection). Numbers will vary based on outlet valve and connection type/size selected.
- Hydrant size recommendations made on case-by-case basis.
- These recommendations are based on hazards present and water flow required for suitable protection
- 6" riser/hydrant (approximate Cv = 950)
 - 1,000 gpm - 1 psi loss
 - 2,000 gpm - 4.5 psi loss
 - 3,000 gpm - 10 psi loss
- 8" riser/hydrant (approximate Cv = 730)
 - 3,000 gpm - 3 psi loss
 - 4,000 gpm - 5.3 psi loss
 - 6,000 gpm - 12 psi loss

- 10" riser/hydrant (approximate Cv = 2670)
 - 6,000 gpm - 5 psi loss
 - 8,000 gpm - 9 psi loss
 - 10,000 gpm - 14 psi loss

[0011] The instant invention includes a swivel for, use with existing hydrant manifolds as well as for use with its own manifold. The swivel for existing hydrant manifolds offers an alternative for facilities who embrace the importance of having non-fixed hydrant manifolds but already have fixed hydrant manifolds in place. With a swivel conversion a standard non-swiveled hydrant manifold can be converted into a swiveled hydrant. E.g. an end user can unbolt a standard non-swiveled hydrant manifold from the typical hydrant manifold inlet valve or riser pipe, place a conversion swivel on top of the inlet valve or riser pipe and then place the hydrant manifold on top of the swivel. The conversion allows the existing hydrant manifold to swivel and be locked into place via a positive locking mechanism.

[0012] A bottom fitting of the swivel is preferably stationary and does not move relative to the ground. A top portion of the swivel, preferably with a locking element and upper flange, preferably locks in the needed direction and can rotate 360 degrees. Preferably the top portion of the swivel and attached hydrant can be secured in a desired direction and fixed, such as pinned into place via mateable locking holes that register every 22.5 degrees (16 positions) for instance.

SUMMARY OF THE INVENTION

[0013] The invention discloses a swivel for use with or for, a hydrant manifold for industrial fire fighting. The swivel with a hydrant manifold comprises a hydrant manifold and a swivel connected thereto, structured to connect to an industrial water supply pipe system, including inlet and valve or riser pipe. The swivel provides at least a 6 inch flow conduit and preferably includes mating male and female stainless steel sleeves, structured for relative rotation, having at least two rings of steel ball bearings between them, and including an interior water seal and preferably an exterior debris seal. The manifold may be horizontal or vertical. Male and female stainless steel swivel sleeves are preferably structured for welded connection to the hydrant manifold, on the one hand, and to a pipe or fitting likely connecting to an aboveground valve of an industrial water pipe supply system, on the other hand.

[0014] Preferably the swivel includes grease fittings for lubricating the area between the sleeves and around the bearings, and the sleeves and bearings are preferably constructed of 316 stainless steel, and include a locking mechanism, such as a pair of locking flanges. More preferably, the swivel of the instant invention incorporates flanges or flange portions on the male and female sleeves with mating holes such that a pin can be placed through

the holes to lock the swivel in place.

[0015] The invention includes a swivel device for connecting to existing hydrant manifolds. The swivel device comprises a first fitting structured to fixedly attach to an inlet valve or riser pipe and a swivel body structured to sealingly and rotatably mate with the first fitting, the body providing a second fitting to fixedly attach, directly or indirectly, to a hydrant manifold. A locking device is preferably included for setting a rotatable attachment position between the swivel body and the first fitting. The first fitting and the swivel body preferably provide an at least 6 inch fluid conduit between the first fitting and second fitting.

[0016] It should be clear that the swivel can connect directly or indirectly between the hydrant manifold and the industrial water supply pipe system. Preferred embodiments show the swivel connected in a simple and direct fashion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] A better understanding of the present invention can be obtained when the following detailed description of the preferred embodiments are considered in conjunction with the following drawings, in which:

Figure 1A offers an isometric view of a preferred embodiment of a 6 inch swivel hydrant manifold, the manifold providing two 5 inch or 6 inch Storz discharges and one two and one half inch discharge. Figure 1B offers a top view of the 6 inch swivel hydrant manifold of Figure 1A.

Figure 1C offers a front view of the 6 inch swivel hydrant manifold of Figure 1A, including on the bottom a customer supplied 6 inch flanged water supply pipe (weld neck or socket weld flange required if using butterfly valve,) and also indicating an inlet valve that can be supplied upon request.

Figure 1D provides a side view of the 6 inch swivel hydrant manifold of Figure 1A.

Figure 1E provides a detail from Figure 1D, including a 6 inch swivel, a swivel locking pin and a swivel locking ring, and wherein an attachment to the top of the swivel is free to rotate 360 degrees, and wherein locking rings have holes every 22.5 degrees.

Figure 2A provides an isometric view of a preferred embodiment of an 8 inch swivel hydrant manifold of the instant invention, including 5 inch or 6 inch Storz discharges.

Figure 2B provides a top view of the 8 inch swivel hydrant manifold of Figure 2A.

Figure 2C provides a front view of the 8 inch swivel hydrant manifold of Figure 2A including, on the bottom, an indication of a customer supplied 8 inch water supply pipe (weld neck or socket weld required if using butterfly valve,) and indicating an inlet valve that can be supplied upon request.

Figure 2D provides a side view of the 8 inch swivel

hydrant manifold of Figure 2A.

Figure 2E provides a detail from Figure 2D, indicating an 8 inch swivel, a swivel locking pin and a swivel locking ring and indicating wherein an attachment above would be free to rotate 360 degrees, and that the locking rings have holes every 22.5 degrees.

Figure 3A provides an isometric view of a 12 inch swivel hydrant manifold of a preferred embodiment of the instant invention, and including a single 12 inch Storz discharge.

Figure 3B offers a top view of the 12 inch swivel hydrant manifold of Figure 3A.

Figure 3C offers a front view of the 12 inch swivel hydrant manifold of Figure 3A, including indicating, on the bottom, a customer supplied 8 inch water supply pipe (weld neck or socket weld required if using butterfly valve,) and indicating an inlet valve that can be supplied upon request.

Figure 3D provides a side view of the 12 inch swivel hydrant manifold of Figure 3A.

Figure 3E provides a detail of Figure 3D, indicating a 12 inch swivel with two swivel locking rings and a swivel locking pin and wherein an attachment above would be free to rotate 360 degrees, and that the locking rings preferably have holes every 22.5 degrees.

Figure 4A provides an isometric view of a typical tank farm including an indication of a location for the instant swivel hydrant manifold invention, which invention would provide the advantages of reducing hoses required by eliminating initial bend radius (as much as 100 feet per hose); reducing road blockage by directing hoses along side of road instead of bend radius occupying roadway; providing shorter hose run which results in reduced friction loss; providing suitability for highly congested areas by more effective discharge of water in the correct direction; providing standard models available for up to 10000 gpm with higher flows possible given engineering approval, and providing that by more effectively supplying water the swivel hydrant design can potentially save as much as 50% of the needed hydrant locations throughout the facility.

Figure 4B illustrates how the swivel hydrant manifold of the instant invention swivels to send water directly toward one of multiple hazards.

Figure 4C offers an enlarged detail view of Figure 4A. Figures 4D and 4E illustrate that while typical hydrant designs face an adjacent roadway and frequently require fire hose to immediately make a large bend radius in order to send water in a needed direction, the instant swivel hydrant invention allows a first responder to aim a hydrant in the necessary direction, to minimize roadway occupation and total hose lay required.

Figure 5A offers a side view of a preferred embodiment of a 10 inch 360 stainless steel swivel joint.

Figure 5B offers a cross-section view of the embod-

iment of Figure 5A, and including noting that castings are preferably investment cast from 360 stainless steel, annealed and stress relieved.

Figure 6A provides an isometric view of a preferred embodiment of an 8 inch swivel hydrant conversion kit.

Figure 6B offers a detail from Figure 6A, including an illustration of a swivel lock fixed element and a swivel lock rotating element and swivel lock pin, (pin chains not shown.)

Figure 6C offers a side view of the 8 inch swivel hydrant conversion kit of Figure 6A.

Figure 6D offers a front view of the 8 inch swivel hydrant conversion kit of Figure 6D.

Figure 6E offers a top view of the 8 inch swivel hydrant conversion kit of Figure 6A.

Figure 7 offers a cut-away view of an 8 inch swivel hydrant conversion kit, with ball bearings and seal not shown inside the swivel.

Figure 8 offers a portion of a cut-away view of an 8 inch swivel hydrant conversion kit, with ball bearings and seal not shown inside the swivel, and wherein two circular grooves represent ball bearing grooves, and illustrating swivel components in greater detail.

[0018] The drawings are primarily illustrative. It would be understood that structure may have been simplified and details omitted in order to convey certain aspects of the invention. Scale may be sacrificed to clarity.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0019] As illustrated in Figs 1-8, a preferred swivel embodiment for the instant invention incorporates 316 stainless steel sleeves FS and MS and ball bearings SB. The stainless steel sleeves are preferably heat treated and annealed. In a preferred embodiment, races RSSB for at least two rings of ball bearings SB are milled, half into a female sleeve FS and half into a male sleeve MS, with a port P provided in the female sleeve for inserting ball bearings SB. At least one grease fitting GF is preferably provided to keep the area between the male MS and female sleeve FS and around the ball bearings SB appropriately lubricated.

[0020] An outside debris seal location DSL is preferably provided, for a debris seal such as an O ring, located in a suitable notch between the male and female sleeves. In preferred embodiments a simple O ring has been shown to prevent debris from entering from the outside into the area between the male and female sleeve. An interior seal IS of a more complex design, preferably of a PTFE or Teflon, is preferably provided in an interior seal location ISL as a water seal for the space between the sleeves and containing the ball bearings. Preferably the inner water seal IS is positioned on shoulders at location ISL between the male and female sleeves such that water pressure drives the seal into greater sealing

engagement between the two sleeves.

[0021] In preferred embodiments a drain is provided in a fitting below the swivel such that when an upstream valve turns off the water supply to the swivel and hydrant, water can drain from the manifold and swivel to the outside.

[0022] Preferably lubricant is provided through at least one grease fitting GF, with maintenance preferably on a schedule of every six months to a year. A lubricant is selected to maintain its viscosity and composition through the range of anticipated environmental and hazard temperature changes.

[0023] Figures 1A-E illustrate a preferred embodiment of a 6 inch vertical swivel hydrant manifold. The manifold of Figure 1A is comprised of a vertical manifold VM welded to a swivel SW. The swivel SW male sleeve MS is indicated having a welded locking ring LR. The swivel female sleeve FS in turn is welded to a fitting FT that has a matching locking ring LR. A pin LP is indicated that locks between the two rings in order to lock the swivel into a location. The female sleeve fitting in turn is structured to optionally mate with an underlying valve IV or the like structure, typically present in many applications, usually a butterfly or wafer valve. The valve in turn mates to the outlet flange of a riser or the like that is part of the industrial water supply system.

[0024] Figures 1B, 1C and 1D offer a top view, front view and side view, respectively, of the preferred embodiment of Figures 1A. Figure 1E offers a greater detailed view of the preferred embodiment of Figure 1A showing the locking rings LR and locking pin LP, male sleeve MS and female sleeve FS, while focusing on the swivel portion SW.

[0025] Figure 2A-2E present a horizontal manifold HM on a 8 inch swivel hydrant. Again a valve IV is indicated on top of a riser flange. A fitting FT interfaces between the valve and the swivel SW and serves to carry one of two swivel locking flange rings LR. The swivel between the fitting and the manifold also carries a locking flange ring LR. It should be mentioned that many other means of locking the swivel could be devised, including a female sleeve port with a screw that tightens down therethrough against the male sleeve.

[0026] Figures 2B, 2C and 2D offer a top view, front view and side view respectively, of the 8 inch swivel manifold of Fig 1A. Figure 2E offers a view of the swivel portion in greater detail for the 8 inch swivel of the hydrant manifold.

[0027] Figures 3A-3E offer views of a 12 inch swivel hydrant manifold. Again, a valve IV opens water flow into the swivel and hydrant manifold, which has with a single 12 inch port.

[0028] Figures 3B, 3C and 3D offer top, front and side views of the 12 inch swivel hydrant manifold of Figure 3A.

[0029] Figures 4A-4E offer a drawing of a preferred tank farm layout overview incorporating the instant hydrant invention. The tank farm layout is shown served by one swiveled hydrant manifold SHM. Figures 4A-4E il-

illustrate the manifold swiveled in a variety of useful directions in regard to the tank farm

[0030] Figures 5A and 5B offer a side view and a cut-away view of a preferred embodiment of a swivel SW portion of the instant invention. An inner male sleeve MS and outer female sleeve FS are shown for this 10 inch embodiment, with three races RSSB for rings of stainless steel ball bearings indicated. In the preferred embodiment the races RSSB for the stainless steel ball bearings SB are milled into the outside of the male sleeve and the inside of the female sleeve. The top of the female sleeve and the bottom of the male sleeve are designed for welded connection to a hydrant manifold and upstream fittings.

[0031] A location for a custom water seal ISL, preferably with an elgiloy spring, is indicated. A grease pressure vent GPV hole is indicated. One or more standard grease fittings are not shown but would be included.

[0032] As mentioned, preferably the sleeve castings are manufactured from 316 stainless steel and annealed and stressed relieved. Ports P are indicated in the female sleeve through which the ball bearings are loaded. Preferably a water seal is specifically designed for its chamber ISL in order to seal tightly against water leakage under the pressure of water through the swivel. A PTFE or Teflon seal is preferred.

[0033] As discussed above and illustrated in Figs 6, 7 and 8, a preferred swivel SW incorporated into a "conversion kit," for use with or for a hydrant manifold, is shown, preferably incorporating 316 stainless steel sleeves, preferably with rotatably mating male MS and female FS sleeves with ball bearings SB between the sleeves. Stainless steel sleeves are preferably heat treated and annealed. In a preferred embodiment races RSSB for at least two rings of ball bearings are milled, half into a female sleeve FS and half into a male sleeve MS, with a port P provided in the female sleeve for inserting the ball bearings. At least one grease fitting GF is preferably provided to keep the area between the male and female sleeve and around the ball bearings appropriately lubricated.

[0034] An outside debris seal DS is also preferably provided, such as an O ring, located in a suitable notch DSL between the male and female sleeve. A simple O ring can prevent debris from entering from the outside into the area between the male and female sleeves. An interior seal of a more complex design, preferably of a PTFE or Teflon, is preferably provided in an interior seal location ISL as a water seal for the space between the sleeves containing the ball bearings. Preferably the inner water seal is positioned on shoulders between the male and female sleeves such that water pressure drives the seal into greater sealing engagement between the two sleeves.

[0035] In preferred embodiments a drain is provided such that when an upstream valve turns off the water supply to the swivel and hydrant, water can drain from the manifold and swivel to the outside.

[0036] Preferably lubricant is provided through at least one grease fitting GF, with maintenance preferably on a schedule of every six months to a year. A lubricant is selected to maintain its viscosity and composition through the range of anticipated environmental and hazard temperature changes.

[0037] Figures 6A-6E, 7 and 8 in particular offer view of a preferred embodiment of a swivel SW as a conversion kit for use with a hydrant manifold. An inner male sleeve MS and outer female sleeve FS are shown for an 8 inch embodiment, with two races RSSB with places for stainless steel ball bearings indicated. In the preferred embodiment the races for the stainless steel ball bearings RSSB are milled into the outside of the male sleeve and into the inside of the female sleeve. The top of the female sleeve and the bottom of the male sleeve are each designed for welded connection, directly or indirectly, to a hydrant manifold on the one hand and to upstream fittings on the other hand. A further location for a custom water seal ISL, preferably with an elgiloy spring, is indicated. A grease fitting GF is indicated. As indicated preferably the sleeves are manufactured from 316 stainless steel and annealed and stress relieved. Ports P are indicated in the female sleeve through which ball bearings are loaded. Preferably a water seal is specifically designed for its chamber ISL in order to seal tightly against water leakage under the pressure of water through the swivel. A PTFE or Teflon seal is preferred.

[0038] As indicated in Figure 7 female sleeve FS functions as a swivel body structured to sealingly, rotatably attach to male sleeve MS which includes (as by welding) a fitting FT for attachment to an inlet valve or riser pipe or the like. An annular locking ring FLR and a swivel locking ring portion LR, with holes that mutually register is provided, preferably such that a pin PN can lock a position between the two locking rings and sleeves.

[0039] Figure 8 illustrates how a pin PN can lock the position between the two locking rings. Figure 8 further illustrates positioning of race rings RSSB for the receipt of ball bearings through ports P. Race rings RSSB are milled on the inside of the female sleeve and on the outside of the male sleeve to register with one another. A location for a seal ISL between the male sleeve and the female sleeve is indicated, the seal functioning to provide sealing rotatable attachment between the male sleeve and female sleeve.

[0040] The foregoing description of preferred embodiments of the invention is presented for purposes of illustration and description, and is not intended to be exhaustive or to limit the invention to the precise form or embodiment disclosed. The description was selected to best explain the principles of the invention and their practical application to enable others skilled in the art to best utilize the invention in various embodiments. Various modifications as are best suited to the particular use are contemplated. It is intended that the scope of the invention is not to be limited by the specification, but to be defined by the claims set forth below. Since the foregoing disclosure

and description of the invention are illustrative and explanatory thereof, various changes in the size, shape, and materials, as well as in the details of the illustrated device may be made without departing from the spirit of the invention. The invention is claimed using terminology that depends upon a historic presumption that recitation of a single element covers one or more, and recitation of two elements covers two or more, and the like. Also, the drawings and illustration herein have not necessarily been produced to scale.

Claims

1. A swivel device for an at least 6 inch hydrant manifold for industrial fire fighting, comprising:
 - a first fitting structured to fixedly attach, directly or indirectly, to a hydrant manifold inlet valve or riser pipe;
 - a swivel body structured for sealing, rotational attachment, directly or indirectly, to the first fitting and providing a second fitting structured to fixedly attach, directly or indirectly, to a hydrant manifold;
 - a locking device structured to fix a rotatable attachment position between the swivel body and the first fitting; and
 - wherein the first fitting and the swivel body provide an at least 6 inch fluid conduit between the first fitting and the second fitting.
2. The device of claim 1 including the first fitting having a flange for fixedly attaching to a hydrant manifold inlet valve or riser pipe.
3. The device of claim 1 wherein the second fitting includes a flange for fixedly attaching to a hydrant manifold.
4. The device of claim 1 wherein the locking device includes a locking portion on the swivel body and a locking flange on the first fitting, the locking portion and flange providing holes for the insertion of a pin.
5. The device of claim 1 including mating rotatable male and female sleeves.
6. The device of claim 5 wherein the male and female sleeves include stainless steel.
7. The device of claim 5 that includes at least three rings of stainless steel ball bearings located between the male and female sleeves.
8. The device of claim 7 that includes a grease fitting for communicating lubricant between the sleeves and around the ball bearings.

9. The swivel device of claim 1 wherein each of the at least two sets of stainless steel ball bearings are in part located in a race in the male sleeve.
10. The swivel device of claim 1 wherein each of the at least two sets of stainless steel ball bearings are in part located in a race formed in the male sleeve and a race formed in the female sleeve, the race and the sets of ball bearings structured in combination to provide attachment between the sleeves.
11. The swivel device of claim 1 wherein the mating surfaces of the male and female sleeve present essentially no protuberances.

FIG. 1A

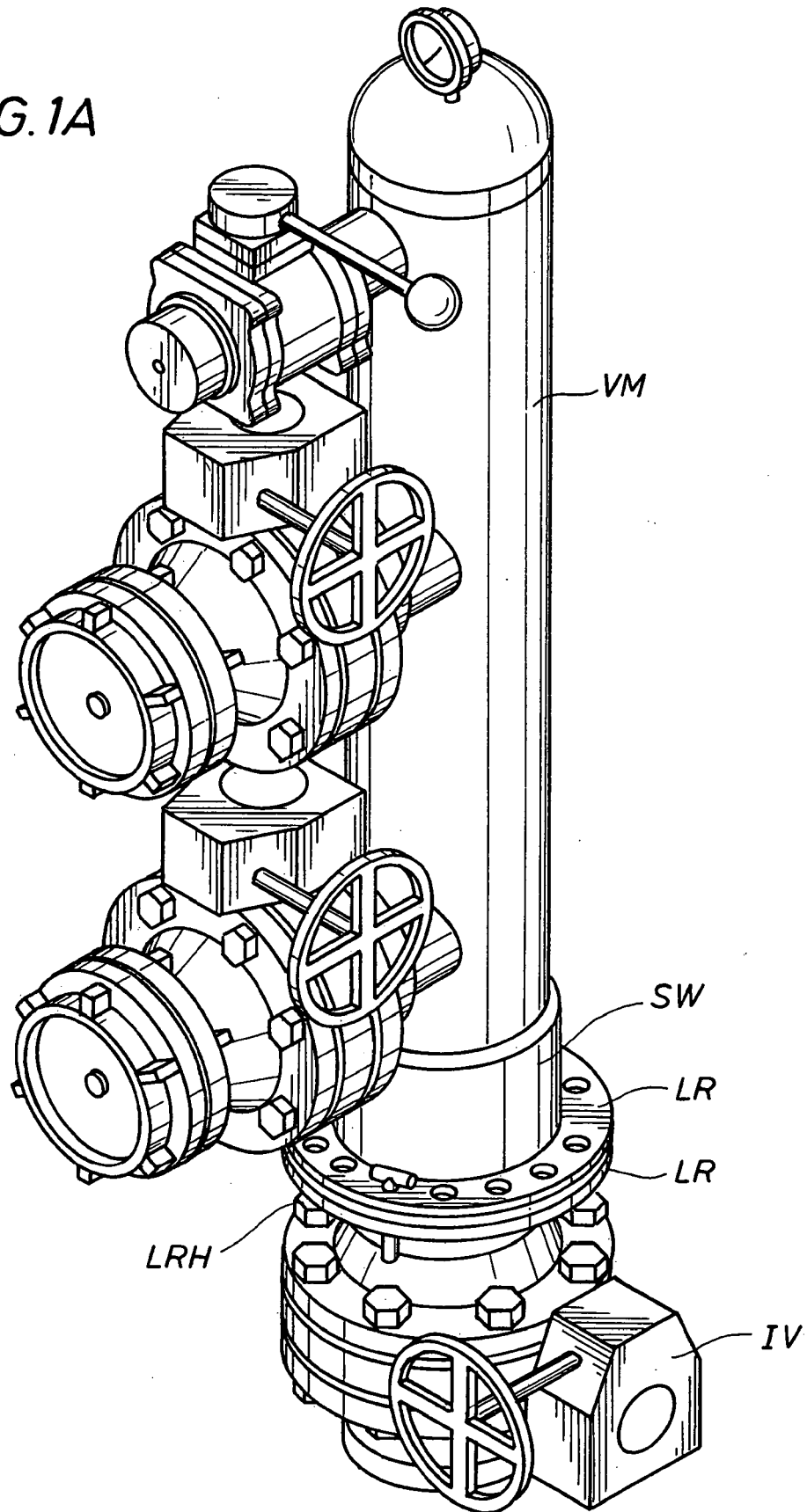


FIG. 1B

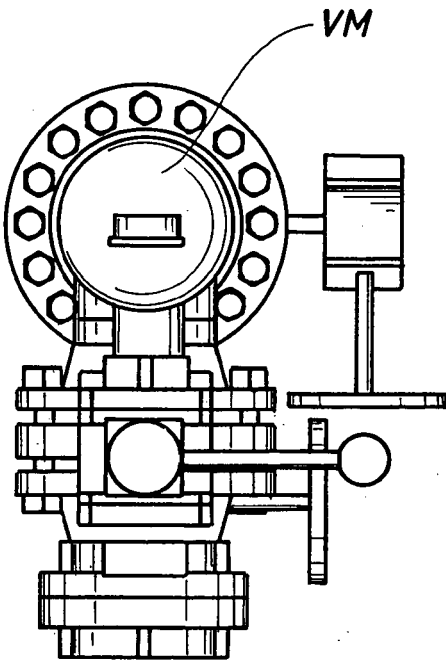
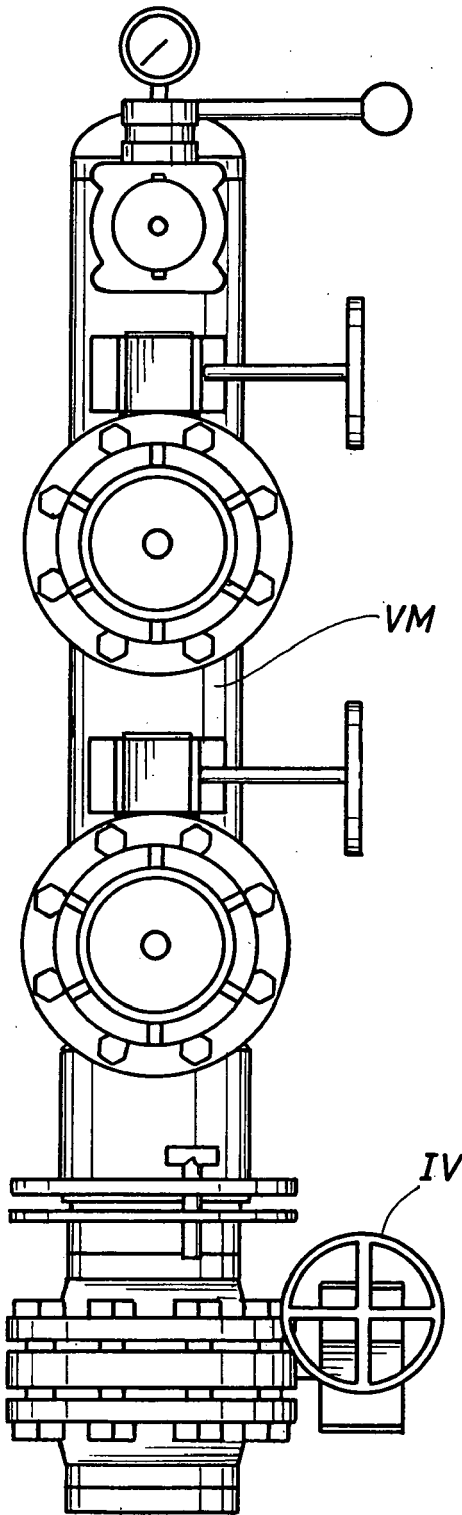


FIG. 1C



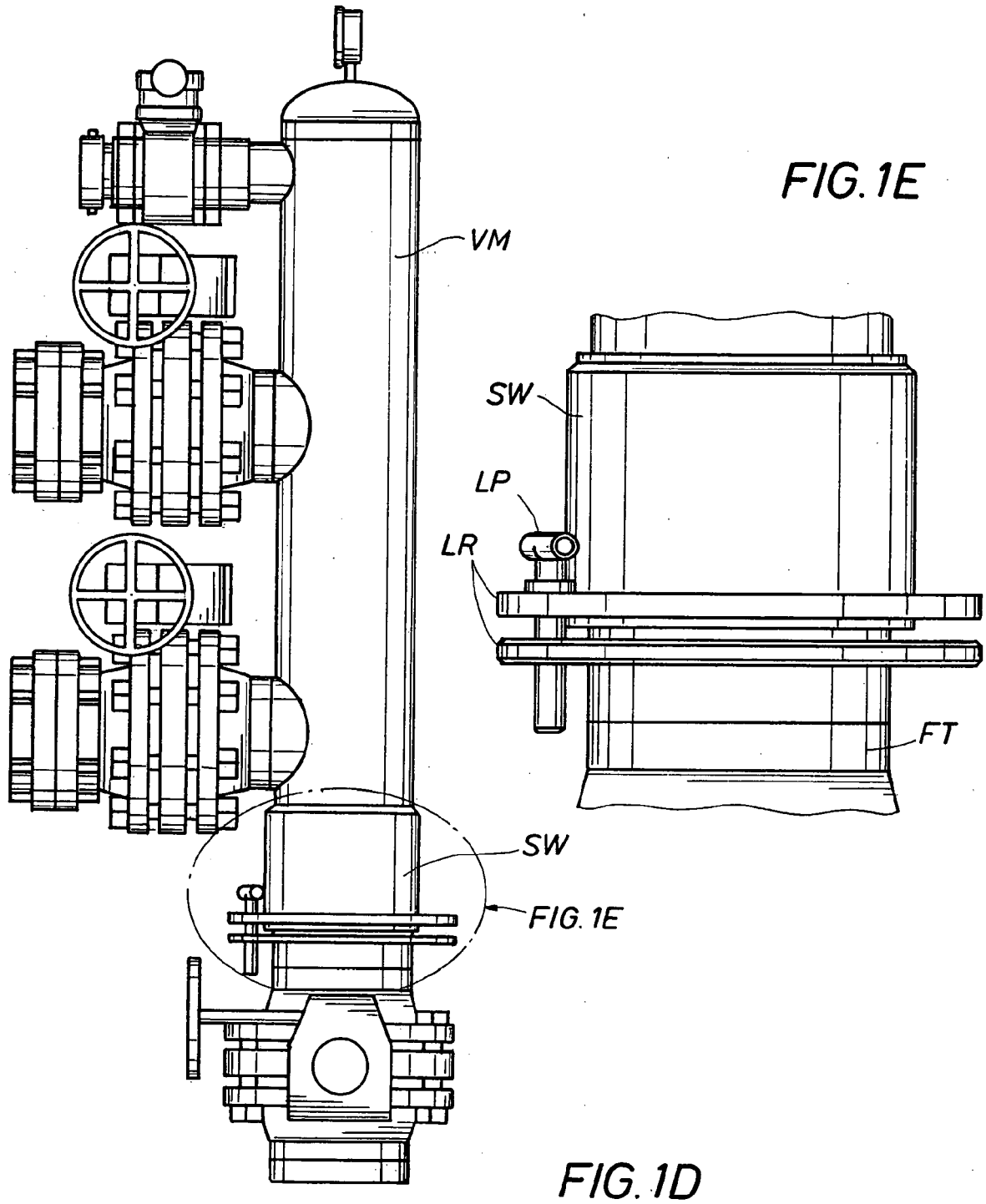


FIG. 2A

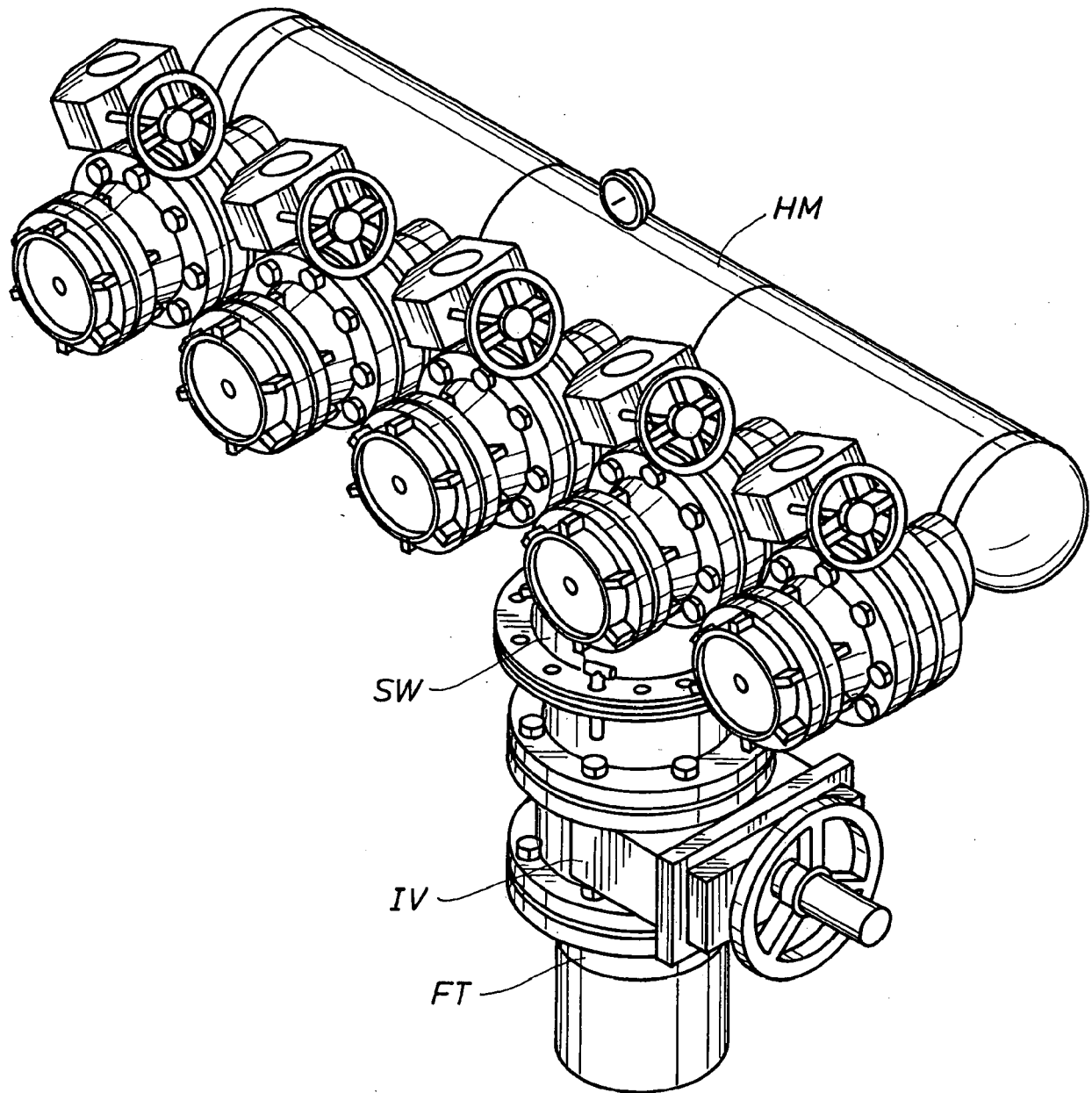


FIG. 2B

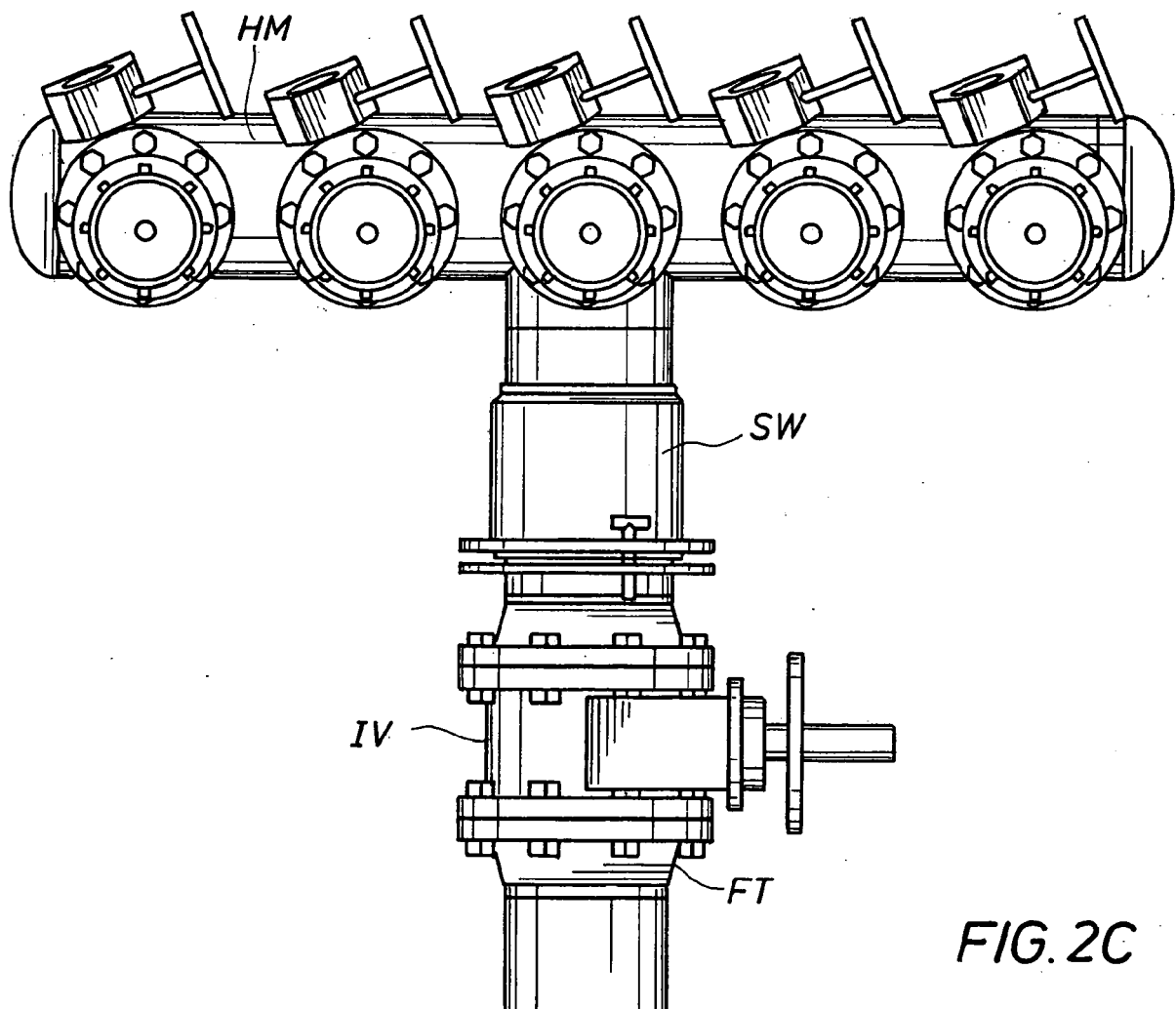
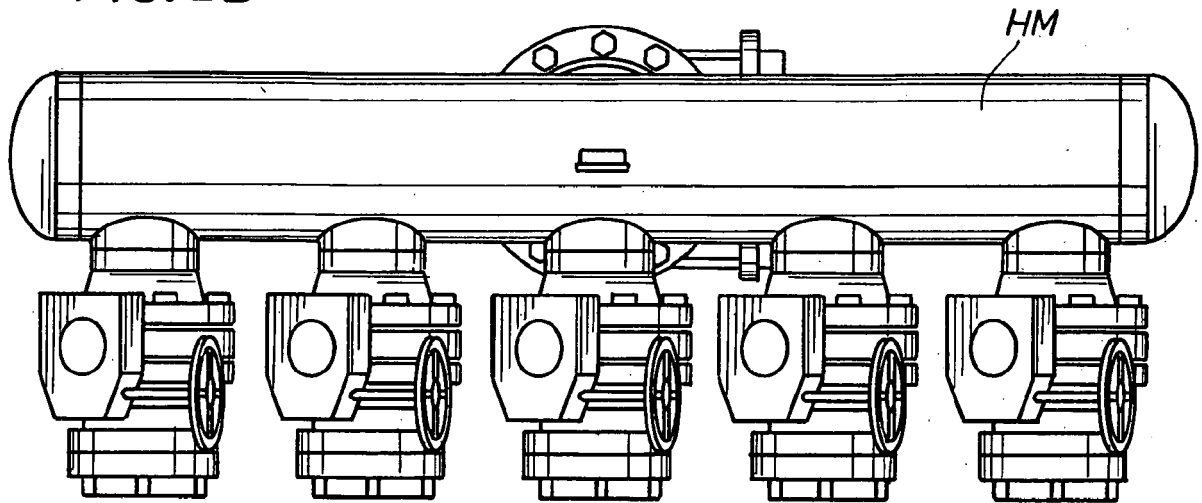
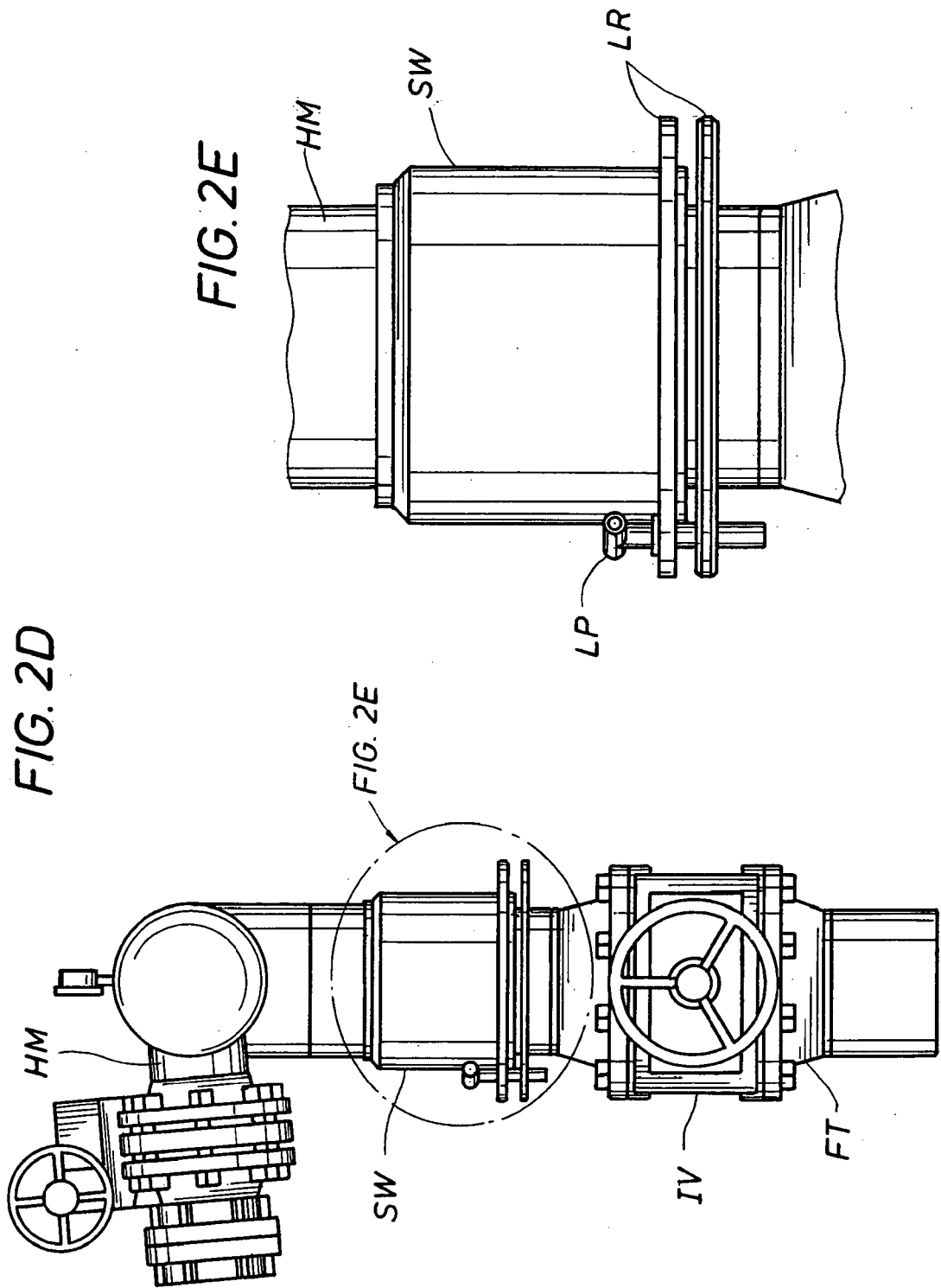


FIG. 2C



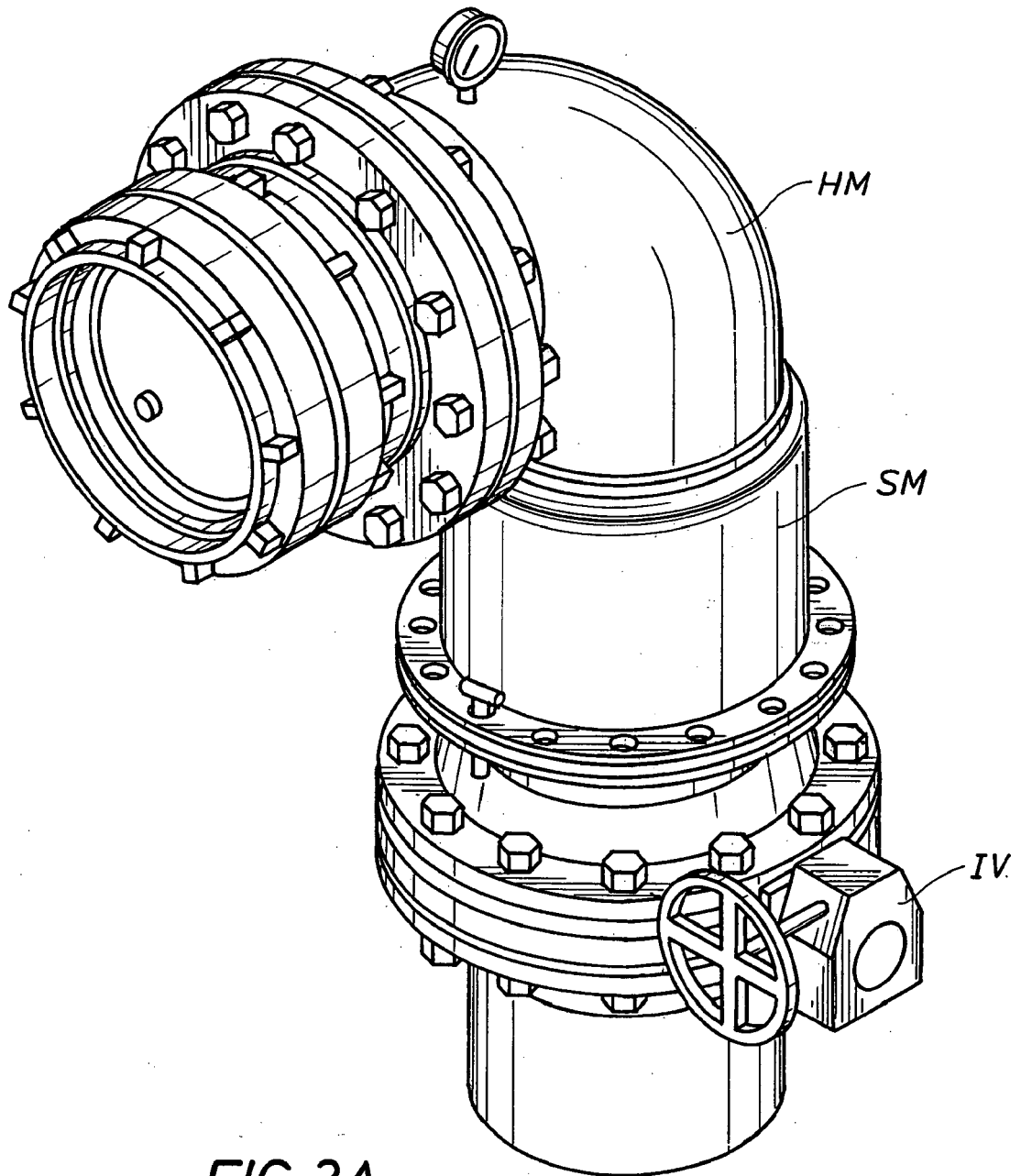


FIG. 3A

FIG. 3B

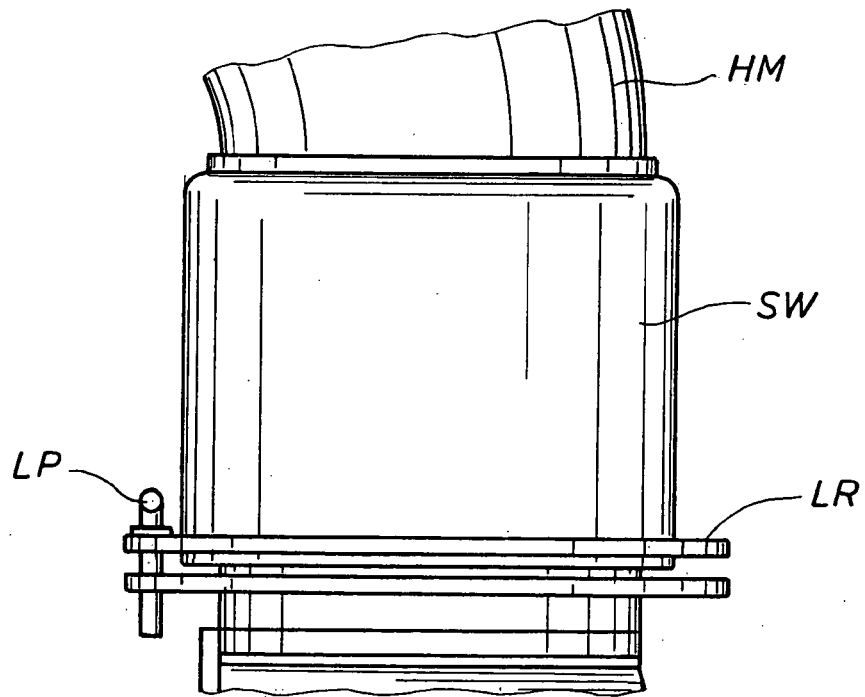
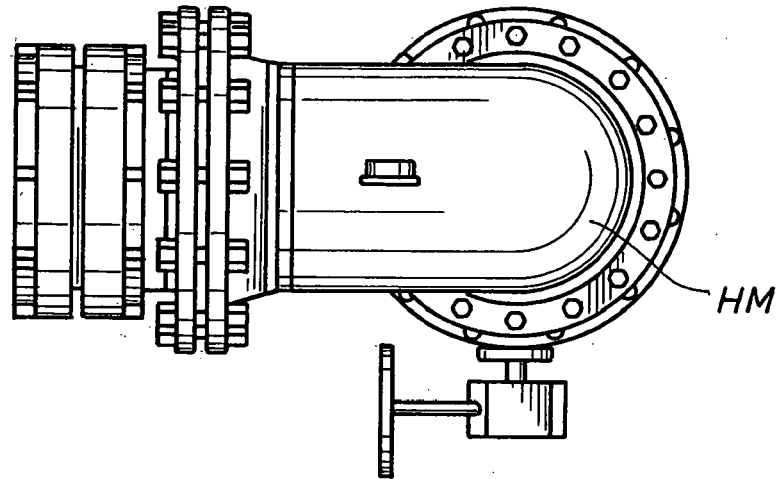


FIG. 3E

FIG. 3C

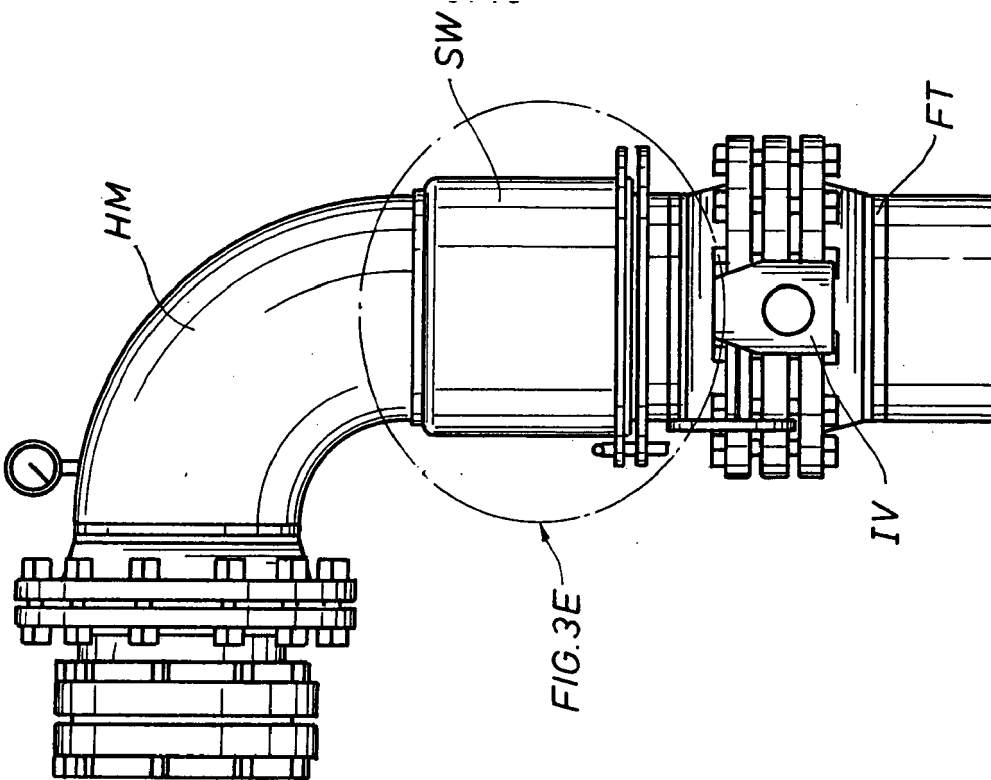
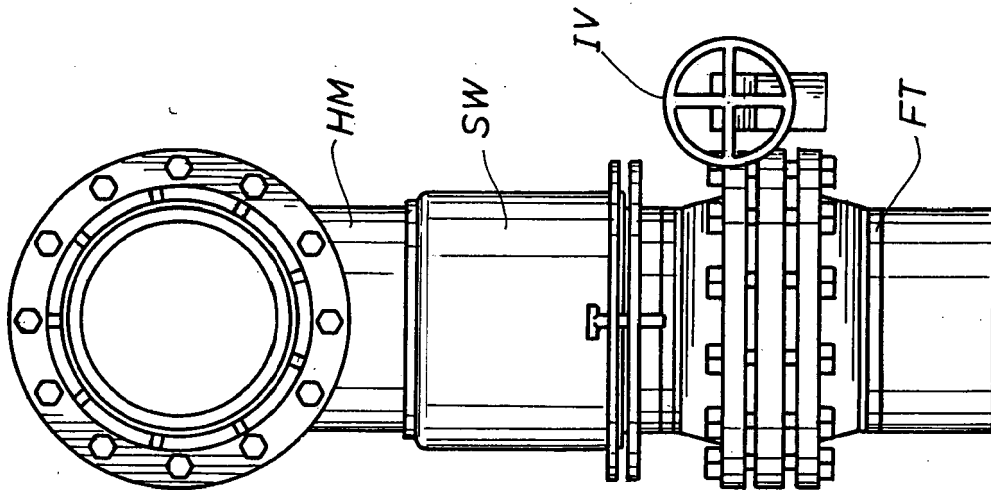


FIG. 3D

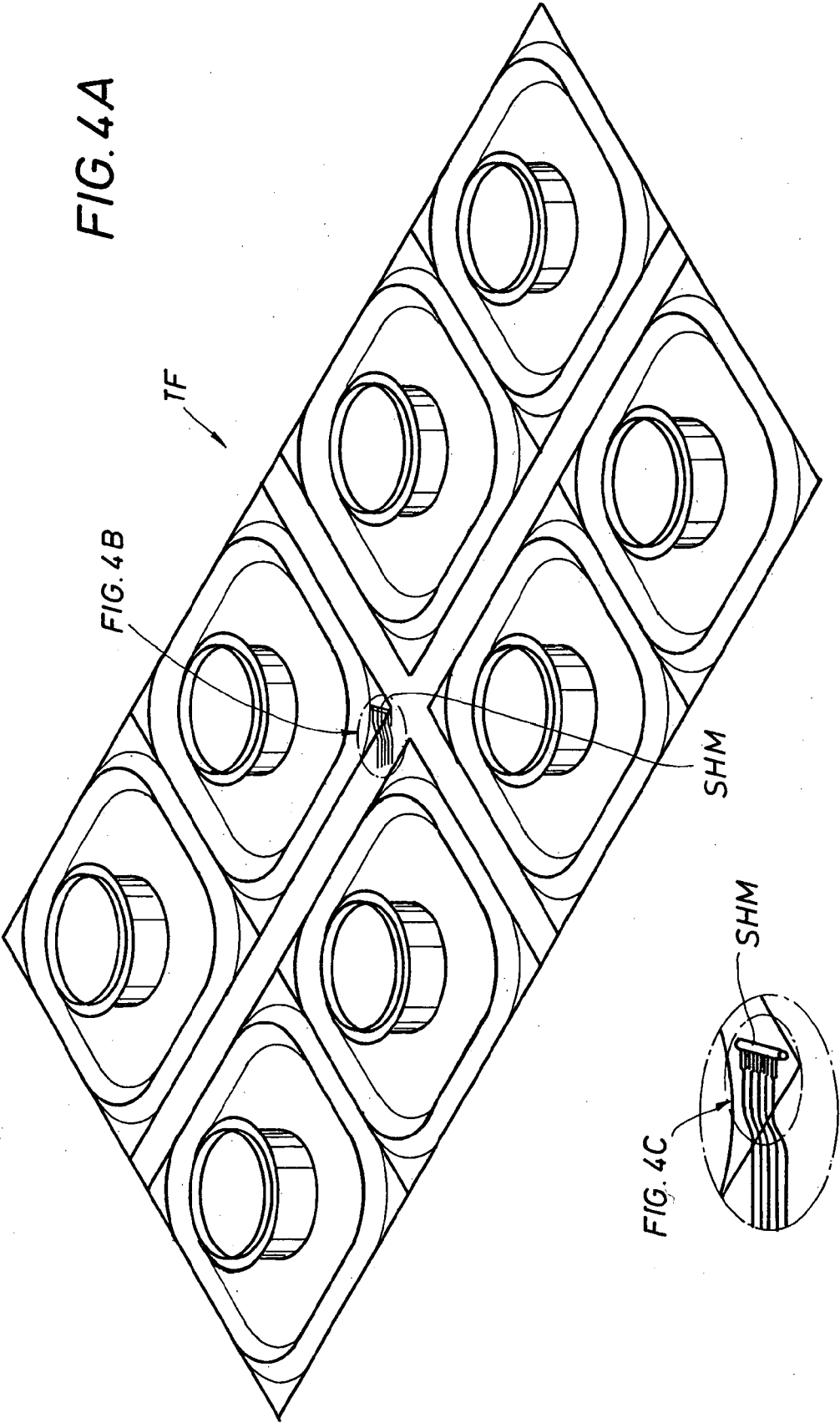


FIG. 4B

FIG. 4C

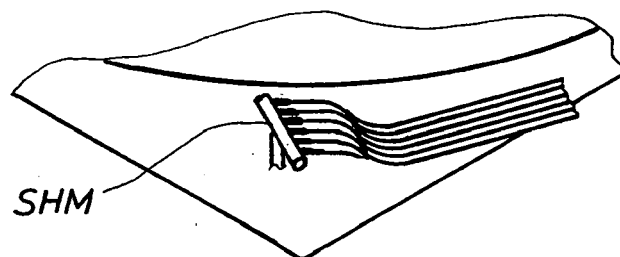
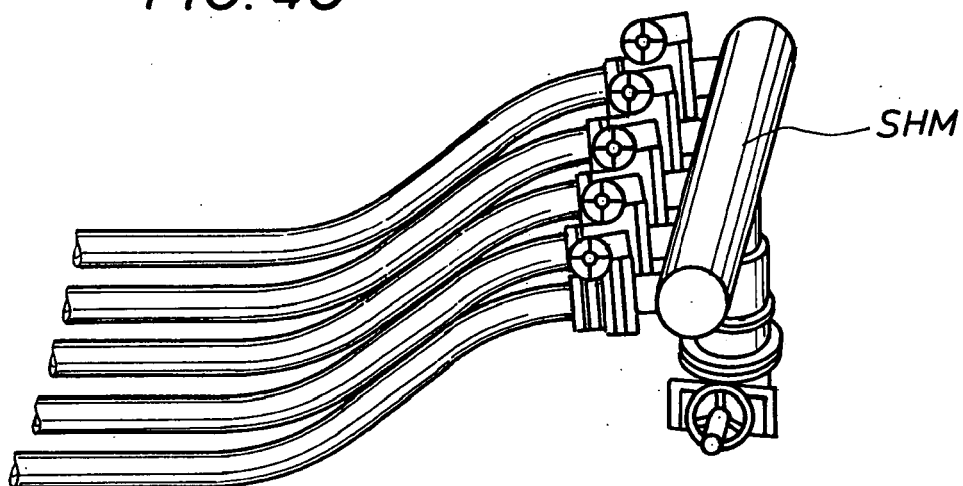


FIG. 4D

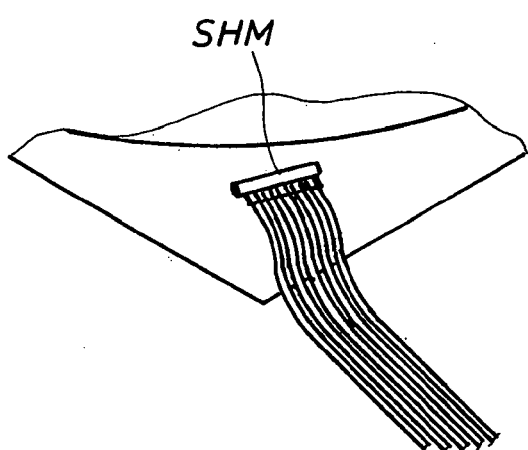


FIG. 4E

FIG. 5A

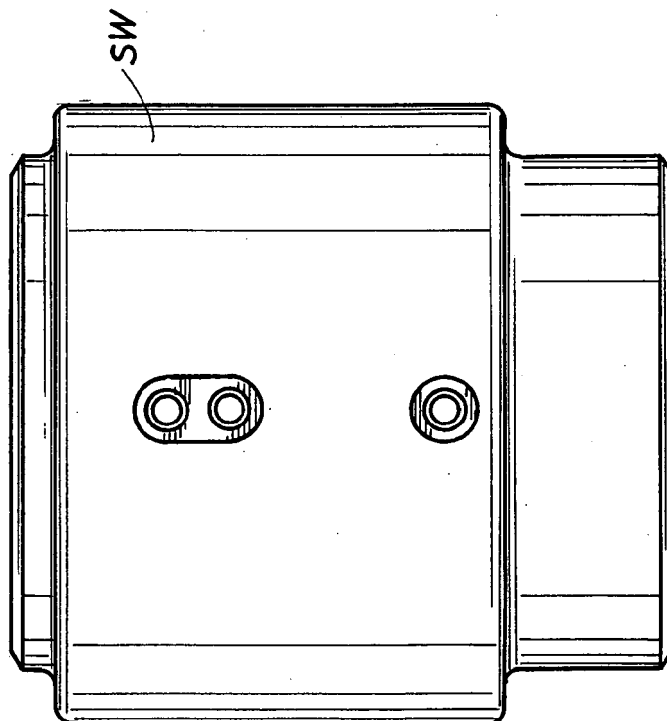
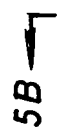


FIG. 5B

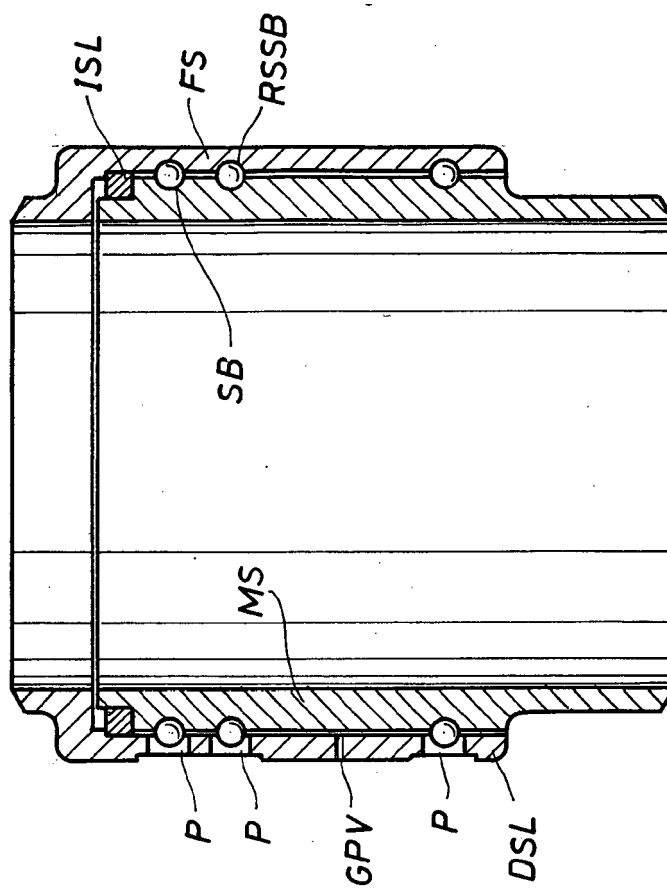


FIG. 6A

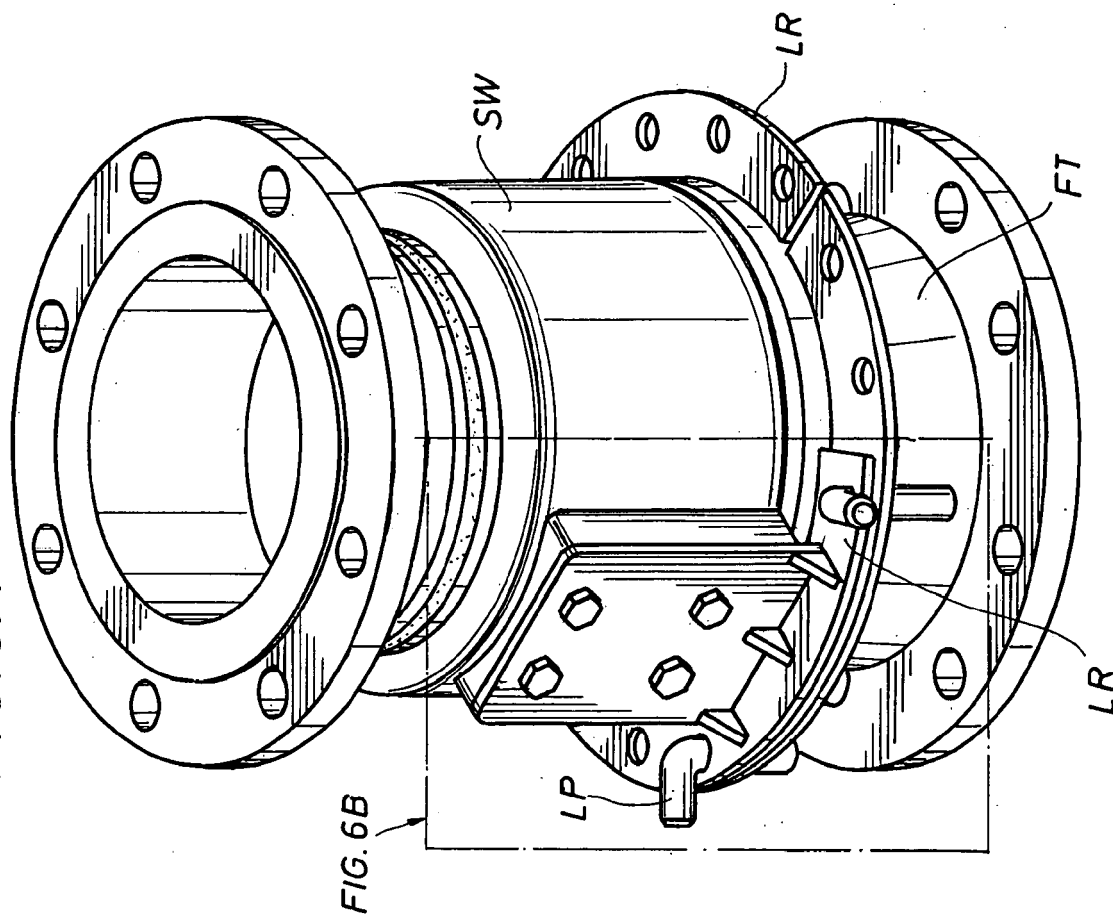


FIG. 6B

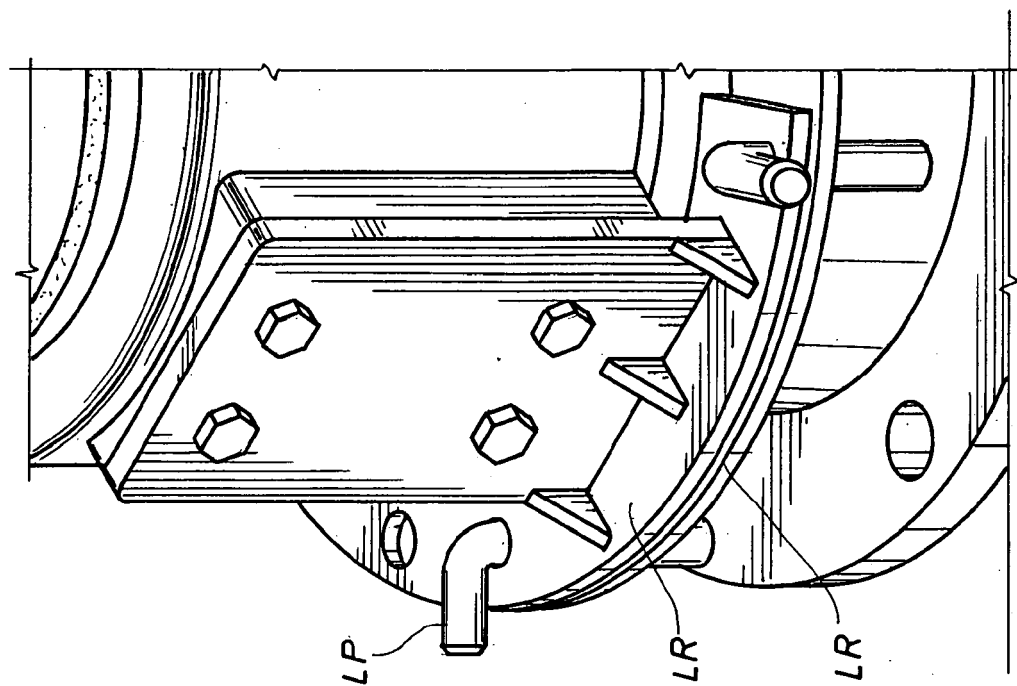


FIG. 6C

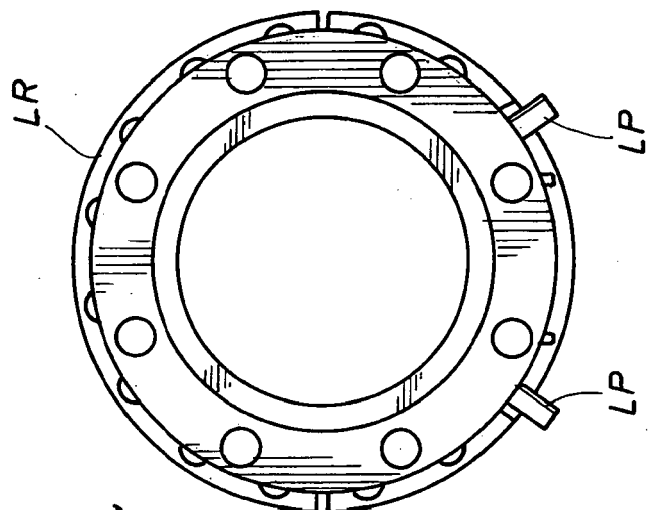
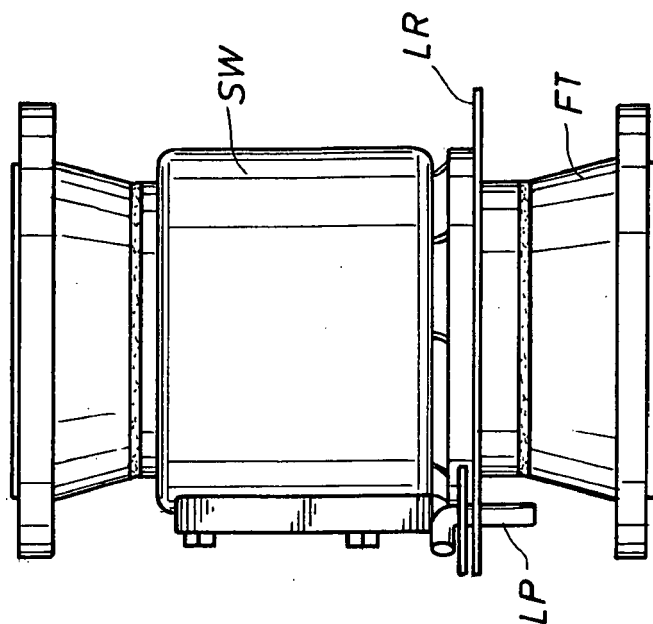


FIG. 6E

FIG. 6D

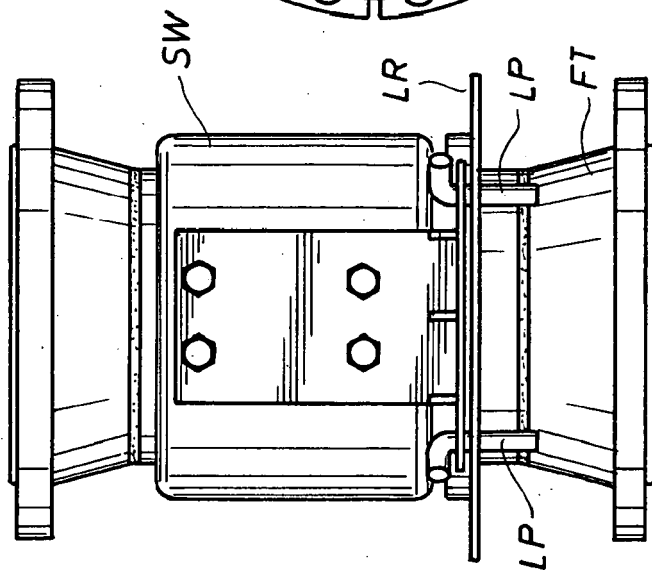
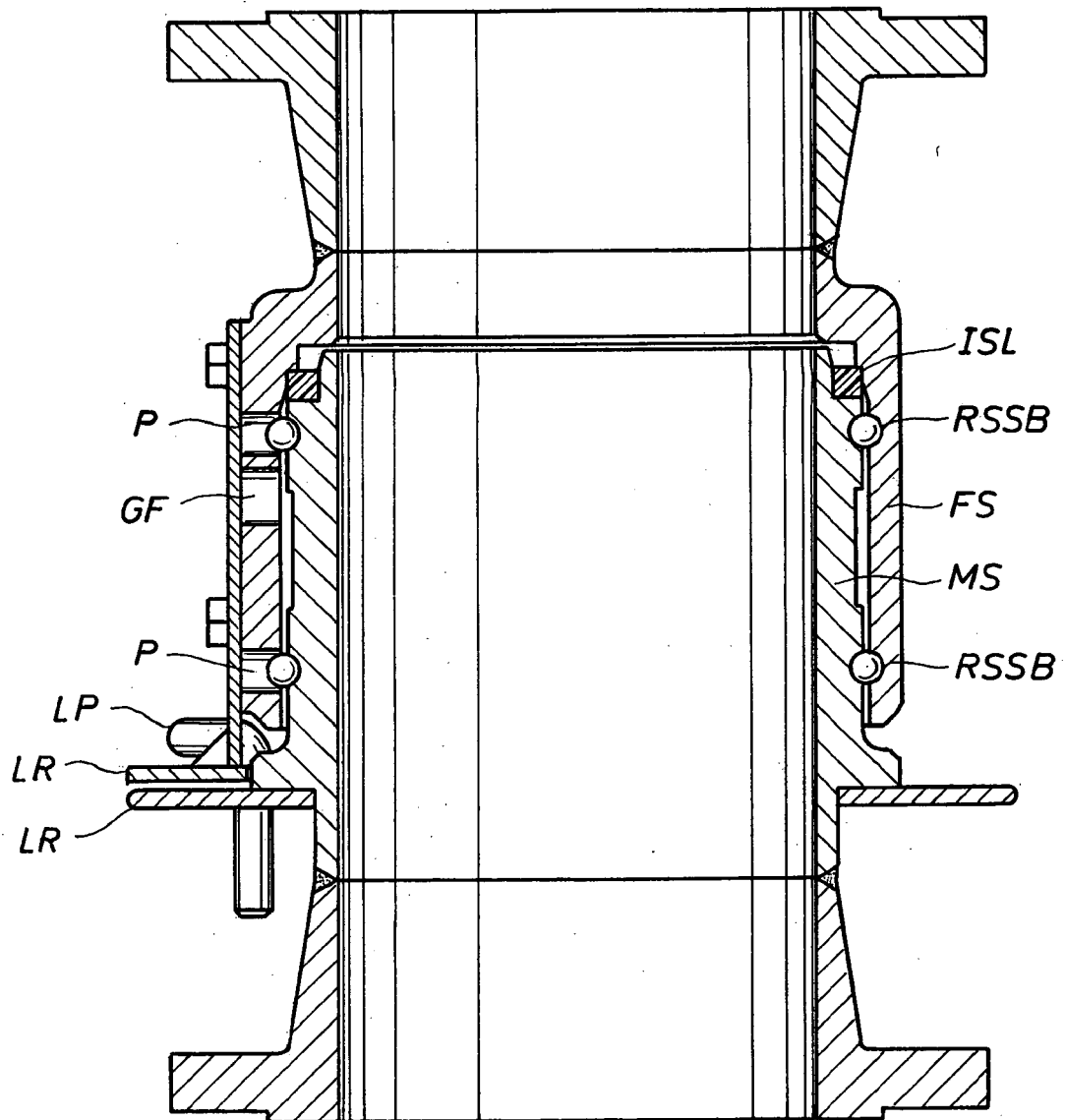


FIG. 7



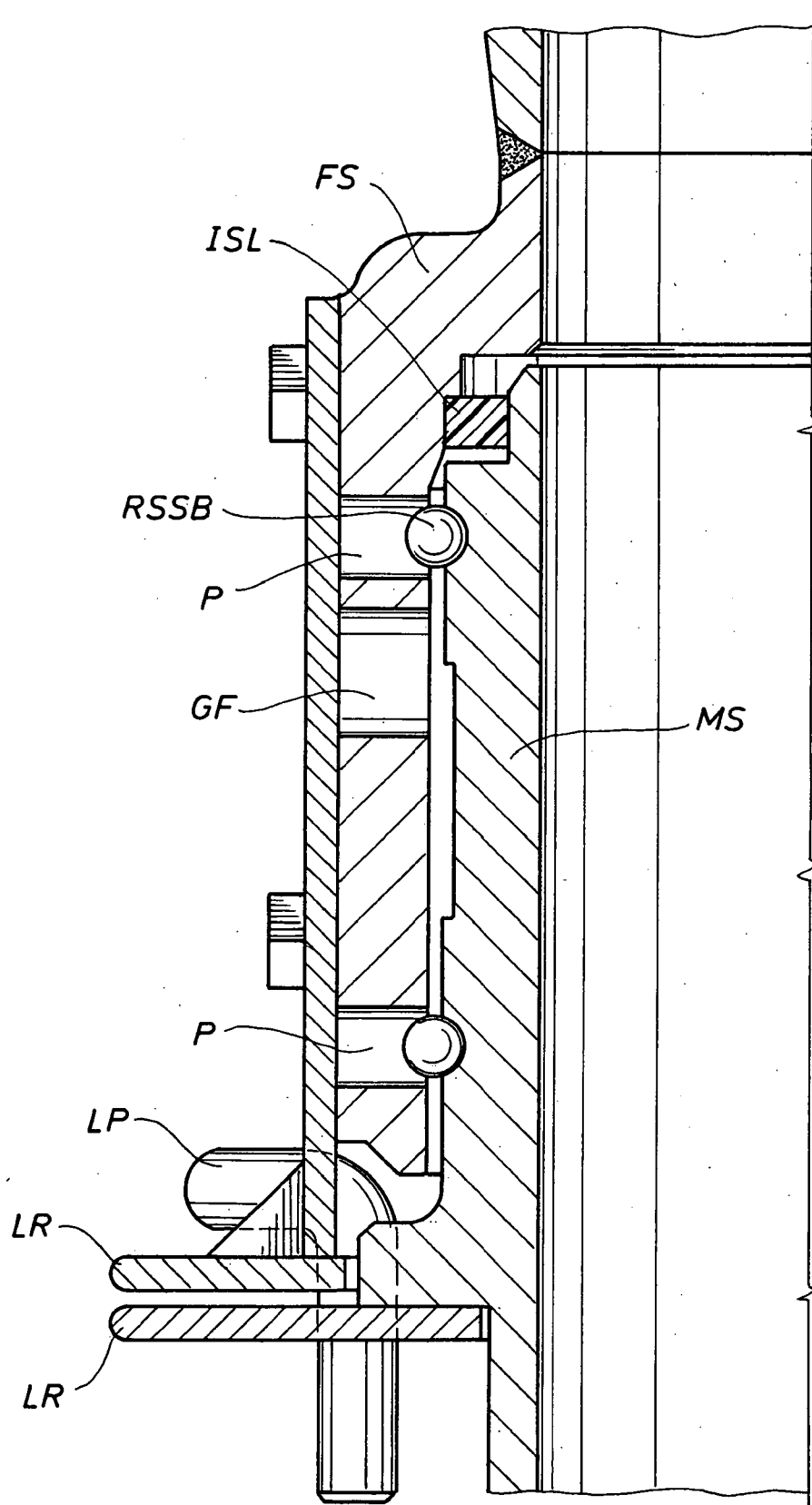


FIG. 8



EUROPEAN SEARCH REPORT

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X	US 2005/145727 A1 (STEINGASS ROBERT W [US] ET AL) 7 July 2005 (2005-07-07) * figure 3 *	1	
X	US 2005/184514 A1 (PETTESCH MARTIN [US]) 25 August 2005 (2005-08-25) * figure 1 *	1,5,11	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) E03B
Place of search Munich		Date of completion of the search 12 August 2021	Examiner Flygare, Esa
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