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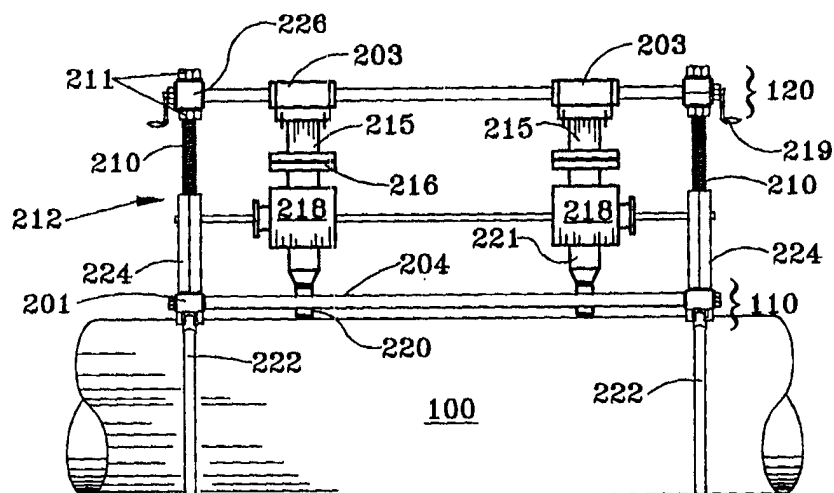
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(54) Title: ALIGNMENT APPARATUS AND METHOD FOR INSTALLATION OF FLOW METER FITTINGS

**(57) Abstract**

An alignment apparatus for properly positioning flow meter fittings for installation of ultrasonic flow measurement device components in a pipeline section. The apparatus uses an adjustable framework mountable on various diameter pipe sections. The framework supports two traveling guide blocks (203) to each of which a variety of flow meter pipe fittings may be attached. In use, the apparatus is used to position and hold a pair of flow meter pipe fittings in proper relation to each other and the outer surface of the pipe section, and on the same radial of and perpendicular to the axis of the pipe while the fittings are fixed to the surface of the pipe. Additionally, a method of using the device is provided. The combined apparatus and method provide the capability to accurately position fitting nozzles onto various size pipe sections for attaching the nozzles thereto, so that subsequent placement of flow meter components in the accurately positioned fittings optimizes flow meter accuracy.

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ALIGNMENT APPARATUS AND METHOD FOR INSTALLATION OF FLOW METER FITTINGS

FIELD OF THE INVENTION

The present invention relates to an apparatus and method for
5 the alignment and installation of flow measurement devices on a
section of pipeline. Specifically, the present invention relates to an
apparatus and method for accurately aligning and positioning pipe
fitting nozzle weld ends to a section of pipe for welding for hot
tapping the pipe section and installing flow measurement device
10 components thereto.

BACKGROUND OF THE INVENTION

The oil, natural gas and petrochemical industries use pipelines
to transfer large quantities of liquid and gaseous substances over
great distances, and also to transact the transfer of ownership of the
15 piped products. Because of the great commercial value of these
transactions, it is very important to the parties to a transaction that
the amount of product actually transferred be as accurately and
precisely measured as possible. In view of the value of the product
transferred, the industry is highly motivated to seek new or
20 alternative technologies for improving the determination of the
amounts of product transferred via pipelines.

Measurement of the flow of a piped liquid or gaseous product
is required for determining the amount of product being
transferred. Typically, measurement of product flow is
25 accomplished by the positioning of flow measurement devices within
the lumen or hollow portion of a section of the pipeline. A number
of such flow measurement devices are known in the art and
accomplish their utility by a variety of means. Fluid flow
measurement devices may be positioned inside a pipe section during

construction of the pipeline. However, it is often necessary to install flow measurement devices into a section of the pipeline after construction, and even while the pipeline is in service and under pressure flow conditions. While it is possible to install a flow measurement device after the pipeline is put into service, such installation can require shunting the flow around the segment of pipeline where the flow measurement device is to be installed, or completely shutting down the flow in the pipeline. Such options are problematic and involve great cost and inconvenience.

Problems of this kind can be avoided by using a "hot tap" technique to install a fitting onto the outer surface of a section of operating pipeline, which results in the fitting having access to the lumen of the pipe section. Subsequently, a flow measurement device is installed in the fitting and inserted into the product flow path in the pipeline. Ultrasonic flow meters are a type of measurement device that may be installed in pipe section of an operating pipeline using the "hot tap" technique. Ultrasonic flow meters measure flow by passing sound waves through the product flow and measuring particular sound wave propagation characteristics. Shutting down or shunting the flow path are not necessary during installation of ultrasonic flow meters since they may be "hot tapped" into place. An example of such an ultrasonic flow meter is the Model 3450 Ultrasonic Gas Flow Meter of Daniel Industries, Inc., Houston, Texas.

The alignment of an ultrasonic flow meter is critical for accurate measurement because of, among other things, the precision of the instrument. An improperly aligned ultrasonic flow measurement device may exceed normal operating parameters by 20% or more. Measurement inaccuracies are primarily due to the

nonuniform installation procedures of ultrasonic flow meters. Typical installation procedures lack the ability to precisely place or position the meters. Additionally, in some instances, the physical layout of the piping prohibits positioning the flow meter in precise
5 locations to measure flow accurately.

It is , therefore, a feature of the present invention to provide an apparatus and method for hot tap installation of flow meter fittings.

Another feature of the present invention is to provide an
10 apparatus and method for accurately positioning valve nozzles or nozzle weldments along a pipeline section for welding the nozzles onto the pipe.

Another feature of the present invention is to provide an apparatus and method such that the pipe is hot tapped at a precise
15 nozzle location and an ultrasonic fluid flow measuring device is attached to the nozzles.

Yet another feature of the present invention is to provide a method for using an apparatus that accurately positions valve nozzles or nozzle weldments with respect to a section of pipeline for
20 affixing the nozzles on the pipe. Since the accuracy of a hot-tapped style metering system is largely determined by the accuracy of its mechanical installation, it is very important to have comprehensive instructions for performing the hot-tap procedure.

Yet still another feature of the present invention is to provide a
25 method for hot tapping the process pipe at each nozzle location and attaching a fluid flow measuring device, such as an ultrasonic flow meter, to the nozzles.

SUMMARY OF THE INVENTION

To achieve the foregoing objects, features, and advantages and in accordance with the purpose of the invention as embodied and broadly described herein is an apparatus or fixture for alignment of
5 flow meter fittings and associated method.

The present invention provides an apparatus or fixture for the alignment of flow meter fittings in various ways, such as for example, a hot tapping procedure. The apparatus securely holds in alignment the center bore of two valve nozzles at a fixed distance
10 from each other. Each nozzle is perpendicular to and on the same radius as the axis of a section of a pipe. The nozzle weld ends are welded or otherwise fixed to the outer surface of the section of pipe. The apparatus comprises one or more traveling blocks or guide blocks for securing the nozzle into position for welding along the
15 pipe. A positioning means is provided for axially positioning the traveling blocks along the pipe. A chassis connects the traveling blocks to the positioning means and supports the apparatus adjacent the pipe. In one embodiment, the positioning means is comprised of a threaded rod or lead screw mating with a threaded passage
20 machined through the traveling blocks. Therefore, when the threaded rods are rotated the traveling blocks will be axially drawn or pushed along the length of the threaded rod. A crank handle, or similar manual or powered mechanism, can be provided to facilitate rotation of the threaded rod. An anchor is also provided for
25 fastening the apparatus in a fixed position onto the pipe while the nozzles are positioned in the desired location. Such an anchor may be, for example, a web strap and ratchet tie down assembly.

In one embodiment, the apparatus comprises a platform base. The platform has a substantially rectangular conformation; the

short sides of which being two lower or base bars and the long sides of which being two lower rods. The bottom side of the rectangular platform has a standoff disposed proximate to each corner for contacting and conforming the platform to the curvature of a pipe section. The upper side of the platform has four upright posts each disposed at a corner of the rectangle. The platform and posts together support a top-frame.

In one embodiment, the top-frame is provided comprising a substantially rectangular configuration. The top-frame has short sides made of two upper bars and has long sides made of two upper rods. The bottom side of the rectangular top-frame is supported on the upright posts located at each corner. The upper rods of the top-frame form rails of a track from which is suspended the two traveling blocks. Each traveling block or guide block is connected to the adjacent upper bar by a positioning means such as a combination lead screw and crank handle. The positioning means is used to set the position of the guide blocks relative to each other along the travel of the track formed by the two upper rods.

The guide or traveling blocks, top frame and platform of the present invention holds the weld end of a nozzle valve assembly or a nozzle weldment assembly in a set position of alignment and for attachment to the surface of the pipe section. An adjustable support assembly may also be provided for supporting in alignment the weight of a pair of nozzle valve assemblies or nozzle weldment assemblies, when the radius of alignment is off-vertical.

In another embodiment of the present invention a method is provided for using the apparatus of the present invention to position and hold a nozzle fitting in a fixed alignment to a pipe for hot tapping and installation of flow measurement component. The

method includes selecting and preparing the installation site on the pipeline, calculating the nozzle spacing, installing the present alignment apparatus, positioning and holding the fittings in alignment, welding or otherwise attaching the nozzles to the pipe,
5 and removing the apparatus.

In still another embodiment of the present invention, a kit is provided. The kit includes a container for holding, storing and transporting the apparatus of the present invention and any ancillary equipment used to install, maintain or operate the
10 apparatus, as well as instructions on a method of use of the apparatus and the ancillary equipment. The container includes transport means to facilitate handling and transport. Such transport means includes casters, handles appropriately fixed to the container, or a dolly. Additionally, the transport means can be
15 removeably attachable to the container.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings which are incorporated in and constitute a part of the specification, illustrate a preferred embodiment of the invention and together with the general
20 description of the invention given above and the detailed description of the preferred embodiment given below, serve to explain the principles of the invention.

FIG. 1 is a side view of a preferred embodiment of the alignment apparatus of the present invention shown with two
25 nozzle fittings and valves mounted in place.

FIG. 2 is a cross-sectional view of the alignment apparatus of the present invention through line 2 as shown FIG. 1.

FIG. 3 is a break-away view of part of the top frame of the present invention showing the relationship of the components of the traveling blocks and positioning means.

FIG. 4 is a perspective view of a portion of the rectangular
5 base platform of FIG. 1, mounted on a pipe.

FIG. 5 is an alternative view of the cross-section of the present invention as shown in FIG. 2.

FIG. 6 is a side view of another preferred embodiment of the alignment apparatus of the present invention illustrating two
10 nozzles weldments mounted in place.

FIG. 7 is a cross-sectional view of the preferred embodiment of the alignment apparatus of the present invention illustrated in taken along the section line 7-7 in FIG. 6.

FIGS. 8A, 8B and 8C are views of the bottom side of a lower
15 bar which forms a short side of the rectangular platform of the present invention.

FIGS. 9A and 9B illustrate details of the adjustable support assembly.

FIG. 10 illustrates a stand-off which is used to contact and
20 conform the platform to the curvature of the outer surface of the section of pipe, and to facilitate rotating the platform about the axis of the pipe.

The above general description and the following detailed description are merely illustrative of the generic invention, and
25 additional modes, advantages, and particulars of this invention will be readily suggested to those skilled in the art without departing from the spirit and scope of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the present preferred
embodiments of the invention as described in the accompanying
5 drawings.

The Apparatus:

The figures illustrate preferred embodiments of an apparatus
of the present invention for the aligned installation of flow meter
fittings onto a pipe section 100. The apparatus is secured to the pipe
10 100 by one or more tie straps 222. The nozzle fittings 221 are
positioned along the pipe 100 and when they are located in the
desired position, the nozzle weld ends 220 are then welded to the
pipe 100. After ensuring that the nozzles 221 are welded in the
correct position, the apparatus is detached from the pipe 100 and an
15 ultrasonic flow meter is installed onto each nozzle fitting 221.

FIGS. 1 through 5 illustrate one embodiment of the apparatus
of the present invention for the alignment of flow meters. In the
illustrated embodiment, the apparatus is comprised of two traveling
guide blocks 203 each threadably connected to a lead screw 206,
20 with each lead screw 206 connected on one end by a rotatable
handle 219 and free on the other end. As depicted in FIG. 3,
rotation of the handle 219 rotates the lead screw 206 to produce
linear movement of the traveling block 203. Each traveling block
203 is supported by two upper rods 205 which form a track upon
25 which the guide block 203 is freely allowed to travel along the axis
of the pipe 100. A nozzle-valve support 215 is secured to the bottom
of each guide block 203 by any of a number of means known to one
of ordinary skill in the art, including a combination of guide pins
and fasteners. Attached to the bottom of each nozzle supports 215 is
30 a valve 218. Each valve 218 has a flange 216 and a nozzle fitting

221 with a butt or nozzle weld end 220. The flange 216 of the valve 218 is connected to the nozzle support 215, and the butt or nozzle weld end 220 is positioned adjacent the outer wall of the pipe 100. The upper rods 205 are parallel and maintained at each end by a pair of upper bar assemblies 226. Each upper bar assembly 226 is preferably supported by a pair of support posts or uprights 212. Each upright post 212 has a threaded portion 210 and, optionally, a non-threaded portion 214. The threaded portion 210 has a pair of threaded nuts 211 or similar fastening means between which the upper bar assembly 226 is fastened. The nuts 211 can be rotated to adjust the elevation of the upper bar assembly 226 with respect to its position on the threaded portion 210 of the support post 212.

As further illustrated in Figs. 9A & 9B, the present invention has an adjustable support assembly 227 combining a bumper bar 240 adjustably connected to a fixed support bar 242 by a plurality of dowel pins 246 mutually inset into adjacent surfaces of both the fixed support bar 242 and the bumper bar 240. The bumper bar 240 is adjustable relative to the fixed bar 242 so that a surface 244 of the bumper bar 240 can contact and accept the weight of fittings mounted in the traveling blocks 203 of the apparatus, especially when the apparatus is mounted to a pipe in an off-vertical position. The bumper bar 240 is adjustable relative to the fixed bar 242 by rotating the dowel screws 247 inset in the fixed bar 242 in-line with the dowel pins 246. Alternatively, the dowel screws 247 and the dowel pins 246 can be integrally combined as a unit. When installed for use in the apparatus of the present invention, the fixed support bar 242 is attached at its ends to the threaded portion 210 of the two support post 212 on a long side of the apparatus, and is positioned along the height of the post 212 end, by a pair of threaded nuts 227a. The adjustable support assembly 227 can be adjusted along

the threaded portion 210 of the support post 212 by rotating the nuts 227a. The contact surface 244 of the adjustable support assembly 227 lies proximate the valves 218 and prevents angular movement of the valves 218 when the apparatus is radially rotated about the
5 axis of the pipe 100.

As shown in FIGS. 8A through 8C, the bottom of each lower bar 201 has one or more channels 232 approximate each end for removeably securing a pair of base blocks or stand-offs 228 in various positions on the bottom of each the lower bar 201. In the
10 embodiment shown, the stand-offs 228 have a pair of friction pegs 230 for insertion into a matching pair of channels 232 on the bottom of each the lower bar 201. Other means of securing stand-offs 228 to the bottom of lower bar 201 are within the skill of and practicable by the ordinary artisan in this field. The
15 stand-offs 228 permit the bottom of the lower bars 201 to conform to the curvature of the pipe 100.

Each lower bar 201 supports a pair of upright support posts 212. The lower bars 201 are inter-connected to each other near their ends by a pair of lower rods 204, thus forming a platform 110
20 having a substantially rectangular configuration.

FIGS. 6 and 7 depict another preferred embodiment of the present invention for the aligned installation of nozzle weldments 317. Since the nozzle weldment 317 is lighter than the combination of a valve 218 and a nozzle fitting 221, an adjustable
25 support assembly 227 is preferably not used.

The method of use and repairing the installation site: Locate the section of the pipeline 100 on which the ultrasonic transducer nozzle fittings 221 or nozzle weldments 317 are to be installed. The nozzles 221 should be installed so that the flow measurement device

has the appropriate length of straight pipeline on either side for the flow conditioning being measured. In the absence of industry standards for single path ultrasonic flow, the following informal requirements for upstream and downstream straight pipe lengths are preferably followed. These are: (1) for unidirectional flow, the transducer assemblies to be installed in the pipeline preferably are 20 nominal pipe size diameter lengths of straight pipe upstream and preferably 5 nominal pipe size diameter lengths of straight pipe downstream; and (2) for bi-directional flow, 20 nominal pipe size diameter lengths are preferred on each side of the measurement device. Before finally choosing the installation location consider the site arrangement for electrical and instrumentation mounting, so that the flow measurement device mounting will be compatible with other equipment, cable or conduit installation.

Then, determine the nominal pipe diameter, nominal wall thickness and grade of pipe material for the pipe section 100 where the nozzle fittings 221 are to be installed. At this point, only the nominal or "book" pipe dimensions are necessary for the preliminary calculations. Then, calculate a preliminary distance L between center lines of the two connections, based on the nominal pipe dimensions using this equation:

$$L = 2(ID)/SQRT(3) + Y$$

where

ID = Nominal OD - 2(WT),

WT = nominal wall thickness of pipeline, and

OD = outside diameter of pipeline.

This preliminary distance L will be used only for the preliminary location of the nozzles. The Y value corrects for any offset of a

particular manufacturer's ultrasonic transducer head relative to the centerline of the nozzle opening. A final L distance for the actual pipe thickness and circumference measurements will be calculated later.

5 The approximate location of the two nozzles 221 is marked. A line is marked along the axis of the pipe having length L, at a section of the pipeline chosen in consideration of the recommended upstream and downstream straight lengths of pipeline. Then, mark the line at its middle, indicating a distance halfway between
10 the two nozzle locations. It is normal practice to locate the nozzles 221 about fifteen degrees off-vertical from the top of the pipe, so that the ultrasonic meter signal will not reflect off the lowest point inside the pipeline, where higher density liquid contaminants or debris may accumulate.

15 At three locations along the length of the pipe 100, mark the circumference at eight (8) spots, spaced about 45 degrees apart starting at the top of the pipe. The exact locations are not critical, since they will be used only to obtain ultrasonic thickness measurements, which will be averaged. If the pipe section 100 is
20 painted or coated, these eight locations will need to be buffed or ground to clean metal in order to take ultrasonic thickness measurement. It is only necessary to remove the coating over approximately a one inch diameter circle to allow the ultrasonic probe to contact the pipe. It will also be necessary to remove any
25 coating in each of the two areas to which the two nozzle fixtures 221 will be attached to the outer surface of the pipe 100 which is an area approximately 6 to 8 inches in diameter.

Measure and record the pipe section 100 circumference at each of the three locations. The outer circumference of the pipe 100

may be measured with a flat tape measure. Alternatively, a welders "wrap-around" may be used to encircle the pipe and marked to indicate the circumference, then laid flat and that distance measured. These three circumference measurements are
5 then recorded.

Measure the thickness of the pipe section 100 at each of the eight spots, for each of the three locations using an ultrasonic thickness gauge, and record these measurements. The ultrasonic thickness gauge used in this step is calibrated per the
10 manufacturer's recommendations, typically using the special gauge calibration that matches the material of the pipeline and the block thickness that is closest to the nominal pipeline thickness. A gel coupling fluid preferable is used when taking thickness measurements. The thickness at each of the eight spots for each
15 location of the three locations is measured with the ultrasonic thickness gauge, and the values recorded.

Set a (digital) level on top of the pipe section 100, and measured and record the slope angle and direction of the slope of the pipeline. Note: it is important to know the direction of slope
20 when making the final check on the installed nozzle angularity.

Calculating Nozzle Spacing: Using data recorded above, calculate nozzle spacing, the distance L, using this equation:

$$L = 2(ID)/SQRT(3) + Y$$

where ID = OD - 2(WT), WT = average wall thickness of pipe
25 determined from the ultrasonic thickness measurements, and OD = outside diameter of pipe averaged over the three measurements taken. Again, the Y value corrects for any offset of a particular manufacturer's ultrasonic transducer head relative to the centerline of the nozzle opening into which it is inserted. This

dimension is one of the critical parameters for installation of the meter, and will be set after the nozzle alignment fixture is secured to the pipeline and properly adjusted.

Installing the Apparatus: The apparatus must be adjusted to
5 the specific size (diameter) of the pipe section 100 on which it is to be used. This adjustment is made by positioning the pair of stand-offs 228 on each lower bar 201 accommodate the pipe's diameter.

Install the apparatus onto the pipeline. Lift the apparatus onto the pipeline, using the eye bolts 223 and attach the tie down straps
10 222. Set a level or digital level along the length of each lower bar 201 in turn to level the platform 110 on top of the pipe 100. Tighten the ratchet 222a on each of the associated tie down straps 222 to secure the apparatus 1 atop pipe 100 with the width of the platform 110 plumb to the vertical top of the pipe 100.

15 Mount the nozzles by assembling the nozzle weldments 317 or the combination nozzle valves 218 and nozzle fittings 221 to the nozzle supports 215, and then mount the assembly onto the traveling blocks 203 of the apparatus. Move the traveling blocks 203 to the approximate nozzle positions desired using the
20 crank handle 219. Lock the traveling blocks into place by tightening the guide block locking knobs 203a against the upper rod 205. One of ordinary skill in the art appreciates a variety of means for accomplishing the tightening of the locking knob 203a against the upper bar 205, and any such means which accomplish
25 this utility are acceptable in the practice of the present invention. Engage the adjustable support bar assembly 227 against the nozzle/valve combination, if the support bar 227 is to be later used to provide added support of the mass of the combination in the rotating step.

Adjust the weld gap or root gap between the nozzle weld end 220 and the surface of the pipe section 100. This is a height adjustment made using the adjusting nuts 211 at each end of the upper bar 226. The gap is adjusted by moving the threaded
5 nuts 211 up or down. A level or digital level is placed along the length of the upper bars 226, and as the height of each end of the upper bar 226 is adjusted to set the weld gap, it is kept parallel with its corresponding lower bar 201, which was previously set at level. This is done so that the entire apparatus remains plumb with
10 respect to the pipe 100 during the weld gap adjustment. The weld gap and the distance from the weld end 220 to the pipe 100 should be set typically in the range of 3/32 to 1/8 inches, depending on the welder's preference. This may be gauged with a piece of wire or welding electrode.

15 Rotating the apparatus to off-vertical. After making the above adjustments, loosen the tie down straps 222 sufficiently to rotate the entire apparatus, and rotate the apparatus some amount, preferable about 15 degrees, off-vertical from the top of the pipe section 100. The lifting device or other means are used to balance its weight
20 until the tie down straps 222 are secured. Also, the direction of rotation should allow the adjustable support bar 227 to help support the weight of the mounted nozzle fitting 221, the valve 218, and the valve support 215 combination. Use a digital level or the like along the length of each lower bar 201 at each end of the apparatus 1, and
25 tighten the tie down straps 222 while maintaining the same angle off-vertical at each end of the apparatus.

Set the distance between the central bore of the nozzle fittings to length L. The apparatus maintains the proper angular and distance parameters of the nozzle weld ends 220 during tack

welding to the pipe section 100. The distance "L" is set on the apparatus by setting the distance between the two traveling guide blocks 203. That is, the distance between the inside edges of the two traveling guides 203 must be set at a distance equal to L minus X, where X is the sum of the distance for each of the traveling blocks 203 from its inside edge to the central bore axis of the nozzle mounted thereon. The distance may be set by use of a vernier caliper of sufficient length for the setting. Be sure to double check that the setting made with the caliper scale was correct by using a separate scale or tape to confirm the measurement.

Move the traveling guide blocks 203 to the desired position, and lock them in place with the locking knobs 203a. Check the distance between the traveling guide blocks 203 to verify the correct weld or root gap, and make corrections as necessary.

Welding the Nozzles: Welding shall be done in accordance with welding procedures selected for the particular application. This phase of the installation requires special care not only because the welding is usually done while the inside of the pipeline is under pressure, but also because it is the most critical operation which controls the final alignment of the nozzles. The welding must be done as uniformly and symmetrically as possible in order to minimize distortion or "drawing" of the nozzle weld end 220 off the desired centerline. Generally, best results are achieved with two welders working simultaneously at 180 degrees apart.

Tack welding of the nozzle weld end 220 to the pipe 100. This is done while the flange 216 is secured to the nozzle support 215 and in turn to the traveling block 203. Heavy tack welds, 1/2 to 3/4 in. long and 1/4 to 3/8 in. thick, should be made in four (4) locations, 90

degrees apart, between the nozzle weld end 220 to the pipe 100 to hold the nozzle 221 firmly in place.

Checking the weld alignment. Allow sufficient time for the tack welds to cool, then unmount the flanges 216 from the nozzle supports 215. Check the gap between each flange 216 and the nozzle support 215 for even, uniform spacing, to assure there has been no irregularity caused by weld metal shrinkage. A feeler gage may be used to determine the gap at points approximately 90 degrees apart around the flange 216. If gap irregularity exceeds the prescribed angular tolerance of ± 0.20 degrees (approximately 0.020 inch from one side of the flange facing to the other side for about a 6.5 inch flange), the welders should be advised to make the necessary correction during welding of subsequent weld passes in order to compensate for the misalignment, and bring the nozzle back to the desired position. Once the gap deviation is within tolerance, the remaining weld passes are completed until the base of each nozzle 220 is completely welded to the pipe 100. If care is taken during tack welding, compensation should not be necessary.

Complete the remaining weld passes until the weld end 220 completely welded to the pipe 100. Allow sufficient time for the welds to cool, then recheck the final spacing between each nozzle flange 216 and the nozzle support 215 for uniformity. The distance between the central bore of the two nozzle flanges 216 is measured, preferably taken with large calipers, and should correspond to the distance L.

Remove the apparatus from the pipe 100. After the above steps are complete, loosen and remove the tie down straps 222, and lift the apparatus from the pipe section 100.

The foregoing description is illustrative and explanatory of preferred embodiments of the invention, and variations in the size, shape, materials and other details will become apparent to those skilled in the art. It is intended that all such variations and
5 modifications which fall within the scope or spirit of the appended claims be embraced thereby. Additional advantages and modification will readily occur to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus, and the illustrative examples
10 shown and described herein. Accordingly, the departures may be made from the details without departing from the spirit or scope of the disclosed general inventive concept.

WHAT IS CLAIMED IS:

1 1. An apparatus for the alignment of flow meters
2 comprising:

3 (a) at least one guide block for securingly positioning a
4 nozzle proximate a pipe;

5 (b) a positioning means for positioning said guide blocks
6 along the pipe;

7 (c) a chassis connecting said guide blocks to said
8 positioning means; and

9 (d) a means for connecting said chassis to the pipe.

1 2. The apparatus as defined in claim 1, wherein said
2 positioning means are comprised of a cylindrical threaded member
3 having threads formed to mate with threads formed on said guide
4 block, wherein axial rotation of said threaded member displaces said
5 guide block along the axis of said threaded member.

1 3. The apparatus as defined in claim 2 wherein said
2 threaded member comprises a means to facilitate axial rotation of
3 said threaded member.

1 4. The apparatus as defined in claim 1 wherein said chassis
2 is comprised of at least one bar positioned parallel to a pipe providing
3 a sliding support upon which said guide blocks axially traverse said
4 pipe, one or more supports maintaining said bars, one or more pins
5 securing said supports a finite distance from the outer surface of the
6 pipe, said pins having a first end and a second end wherein each
7 said first end is attached to the support, at least one block having a
8 first end and a second end wherein the second end of said block is
9 adjacent the outer surface of the pipe and the first end of said block
10 is attached to the second end of said pin.

1 5. The apparatus as defined in claim 1 wherein said means
2 for connecting said chassis to the pipe is comprised of a web strap at
3 each end of the apparatus.

1 6. The apparatus as defined in claim 5 wherein the web
2 strap comprises a combination web strap for encircling the pipe and
3 a ratchet assembly for releaseably engaging and tightening the
4 strap.

1 7. An apparatus comprising a substantially rectangular
2 platform conforming to the curvature of a pipe, and having an
3 upper side having four upright support posts each disposed at a
4 corner of the platform, and the platform and posts together
5 supporting a top frame from which is suspended two traveling
6 blocks each having means for holding and positioning a nozzle weld
7 end approximate a pipe.

1 8. The apparatus of claim 7 wherein the platform
2 comprises a substantially rectangular configuration having short
3 sides and long sides, the short sides being two lower bars and the
4 long sides being two lower rods, and the lower bars each having two
5 ends and a bottom side with a positionable standoff disposed
6 approximately at each end for contacting and conforming the
7 platform to the curvature of the pipe, and a top side approximately
8 each corner of which is disposed one of the upright support posts.

1 9. The apparatus of claim 7 wherein the top frame
2 comprises a substantially rectangular conformation having short
3 sides and long sides, the short sides being two upper bars and the
4 long sides being two upper rods, and the top-frame having a bottom
5 side supported by the upright support posts approximate each
6 corner, and the upper rods of which form rails of a track from
7 which is suspended the two traveling blocks, and each block is
8 connected to the adjacent upper bar by a positioning means.

1 10. A method for positioning and fixing a pair of nozzles to a
2 pipe in alignment for hot tapping and installation of flow
3 measurement components comprising the steps of:

- 4 (a) preparing the installation site;
- 5 (b) calculating nozzle spacing;
- 6 (c) installing the apparatus of claim 1;
- 7 (d) positioning the fittings in alignment;
- 8 (e) fixing the nozzles to the pipe; and
- 9 (f) removing the apparatus.

1 11. The method of claim 10 wherein the preparing step
2 comprises:

3 locating the section of pipeline on which the nozzles are
4 to be installed in consideration of the recommended upstream
5 and downstream straight lengths of pipe;

6 estimating a distance, L, from the center of the bore of
7 one nozzle to the center of the bore of the other nozzle based on
8 the nominal pipe dimensions using the formula:

9
$$L = 2(ID)/SQRT(3) + Y,$$

10 where
11 Nominal ID = Nominal OD - 2(WT),
12 WT = nominal wall thickness of pipeline, and
13 OD = outside diameter of pipeline, and Y is a correction
14 factor;
15 marking three locations corresponding to the ends and
16 middle of a line of length L along the axis of the pipe to
17 approximate a desired location for the two nozzles;
18 clearing the surface of the pipe around its circumference
19 at eight spots spaced about 45 degrees apart starting at the top
20 of the pipe, at the three locations; and
21 measuring the pipe circumference at each of the three
22 locations, the thickness of the pipe at each of the eight spots for
23 each of the three locations, and the slope angle and direction of
24 the slope of the pipe.

1 12. The method of claim 10 wherein the calculating step
2 comprises:
3 calculating the spacing distance "L" using the equation:
4 $L = 2(ID)/\text{SQRT}(3) + Y$, where: ID = OD - 2(WT), WT =
5 average wall thickness of pipe determined from the ultrasonic
6 thickness measurements, and OD = outside diameter of pipe
7 averaged over the measurements taken and Y corrects for
8 any offset of a particular manufacturer's ultrasonic
9 transducer head relative to the centerline of the nozzle
10 opening into which it is inserted.

1 13. The method of claim 10 wherein the installing step
2 comprises:

3 adjusting the apparatus to the specific size of the pipe by
4 positioning the pair of stand-offs on each lower bar to
5 accommodate the pipe diameter;

6 lifting the apparatus onto the pipe;

7 leveling the platform of the apparatus plumb to the
8 vertical of the pipe, and tightening the tie down straps; and

9 mounting a nozzle assembly onto each traveling block.

1 14. The method of claim 10 wherein the positioning step
2 comprises:

3 moving the traveling blocks and mounted nozzle
4 assemblies proximate the desired nozzle positions using the
5 positioning means and fixing them in place with the locking
6 knobs on the traveling block;

7 gapping the space between the nozzle weld end and the
8 surface of the pipe section to a set distance by adjusting nuts at
9 each end of the upper bar, while maintaining the center bore
10 of the nozzles perpendicular to the axis of the pipe;

11 loosening the tie down straps sufficiently and rotating the
12 entire apparatus off-vertical from the top of the pipe
13 sufficiently to avoid anomalous conditions at the bottom of the
14 pipe flow, and tightening the tie down straps while
15 maintaining the same angle off-vertical at each end of the
16 apparatus;

17 setting the distance between the inside edges of the two
18 traveling blocks to a distance of L minus two times the
19 distance from the edge of a traveling block to the axis of the

20 bore of the nozzle mounted thereon, and locking them in place
21 with the locking knobs; and

22 rechecking the distance between the inside edges
23 traveling guide blocks and for the correct weld gap, and
24 adjusting the distance and gap as necessary.

1 15. The gapping step of claim 14 wherein the space between
2 the nozzle weld end and the surface of the pipe section is set within
3 the range of about 1/16 to 5/32 of an inch.

1 16. The loosening step of claim 14 wherein the apparatus is
2 rotated about 15 degrees off-vertical from the top of the pipe.

1 17. The method of claim 10 wherein the fixing step
2 comprises:

3 tacking the nozzle weld ends to the pipe to hold the nozzle
4 firmly in place on the pipe;

5 unmounting the nozzle flanges and from the nozzle
6 supports and checking the gap between each nozzle flange and
7 its nozzle support for irregular spacing;

8 welding the remaining gap until the weld end is
9 completely welded to the pipe while correcting, if necessary,
10 any irregular spacing; and

11 verifying the final spacing between each nozzle flange
12 and corresponding nozzle support.

1 18. The tacking step of claim 17 wherein the tacking of the
2 nozzle weld ends to the pipe is accomplished using heavy tack welds
3 of about $\frac{1}{2}$ to $\frac{3}{4}$ inches long and $\frac{1}{4}$ to $\frac{3}{8}$ in. thick made in about
4 four approximately evenly spaces locations.

1 19. The method of claim 10 wherein the removing step
2 comprises releasing and removing the tie down straps and lifting
3 the apparatus from the pipe.

1 20. A kit comprising:
2 a container for containing the apparatus of claim 7 and
3 ancillary equipment;
4 the apparatus of claim 7;
5 ancillary equipment; and
6 instructions for the use of the apparatus and
7 ancillary equipment.

1 21. The kit of claim 20 wherein the container has transport
2 means to facilitate handling and transport of the container selected
3 from the group consisting of casters, handles and a dolly.

1 22. The transport means of claim 21 being removeably
2 attachable to the container.

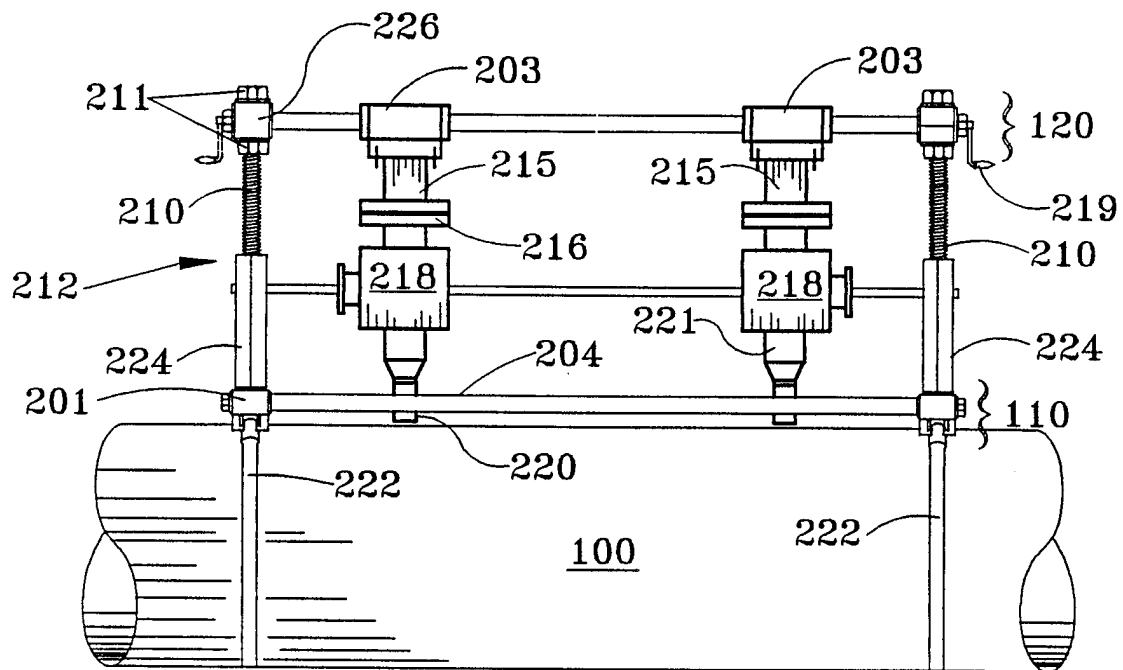


FIG. 1

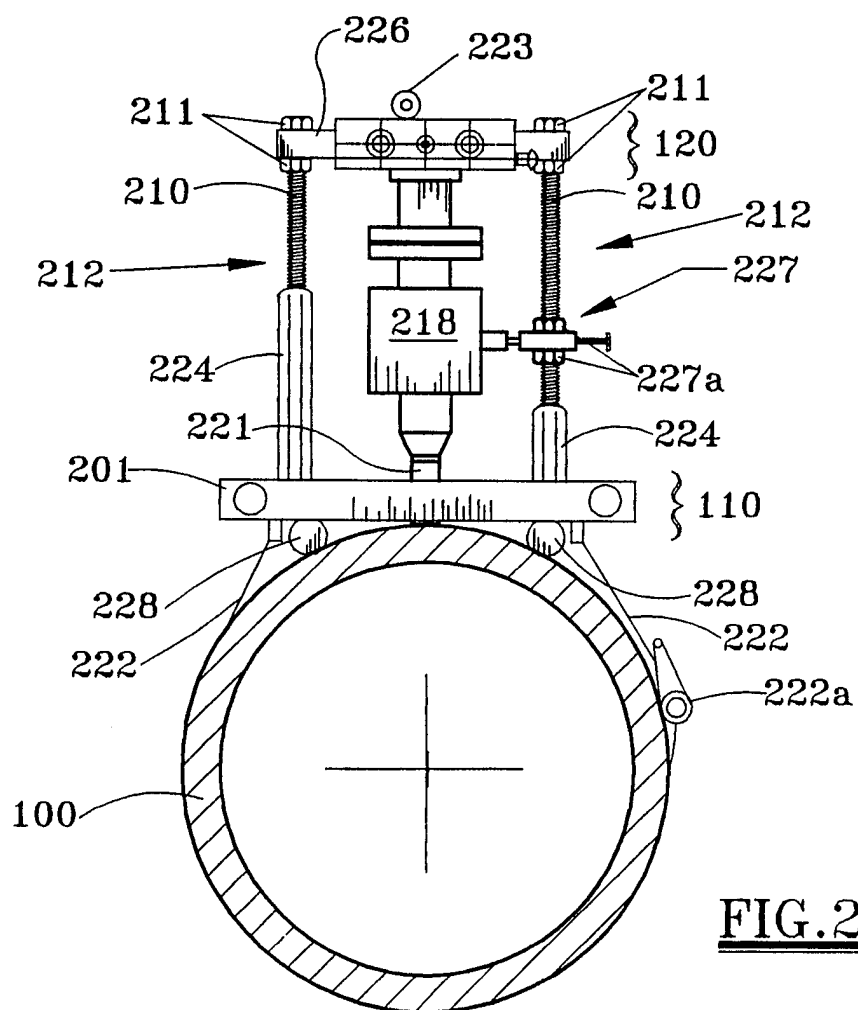
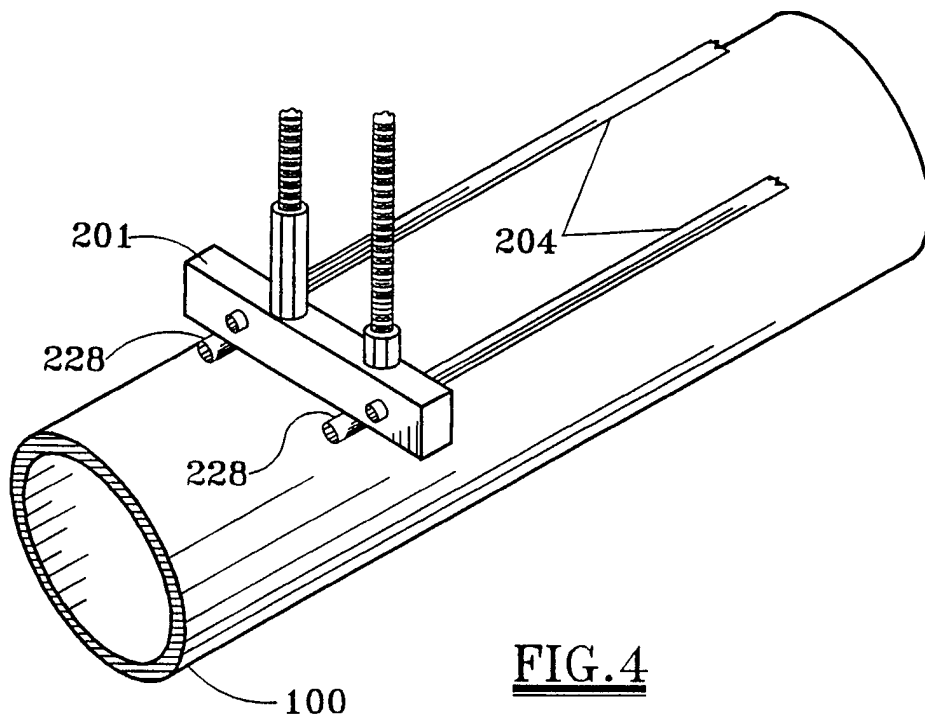
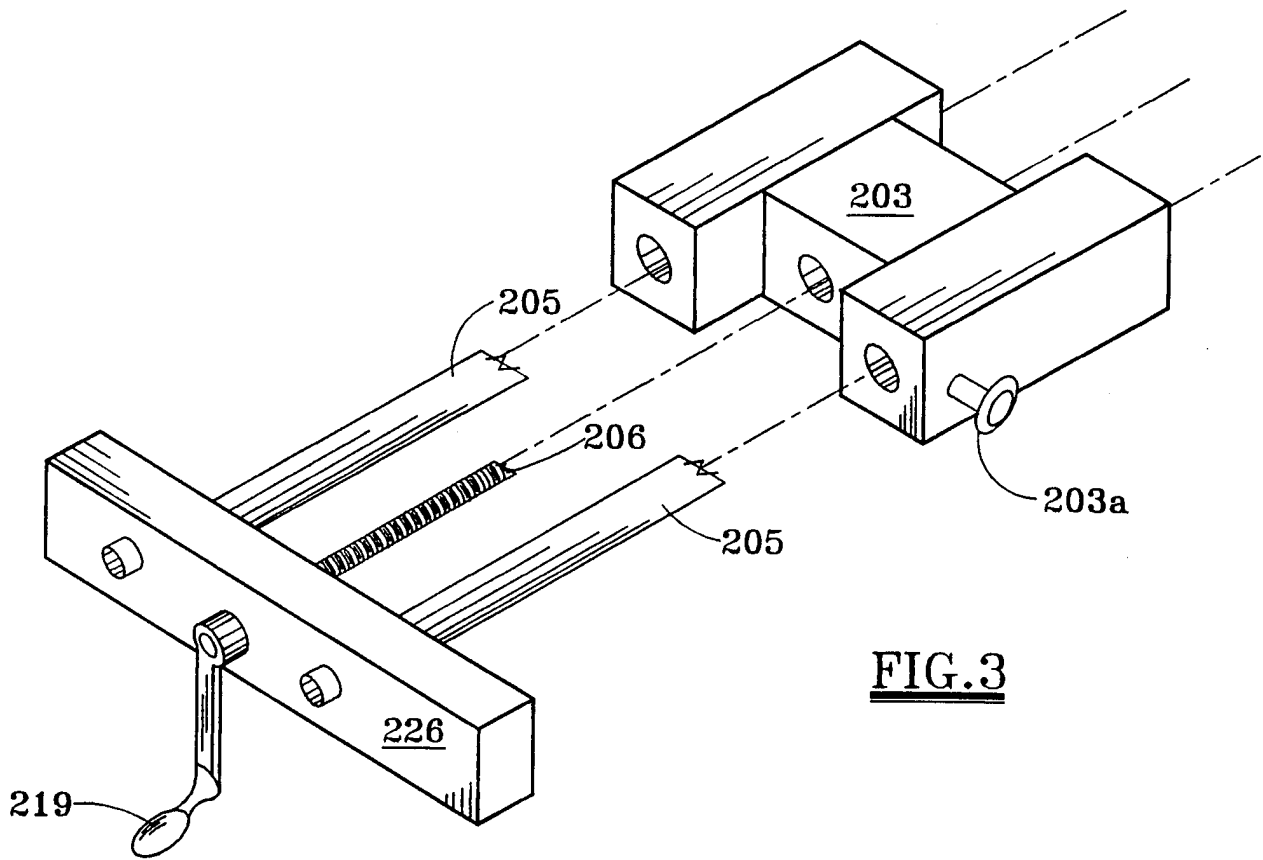
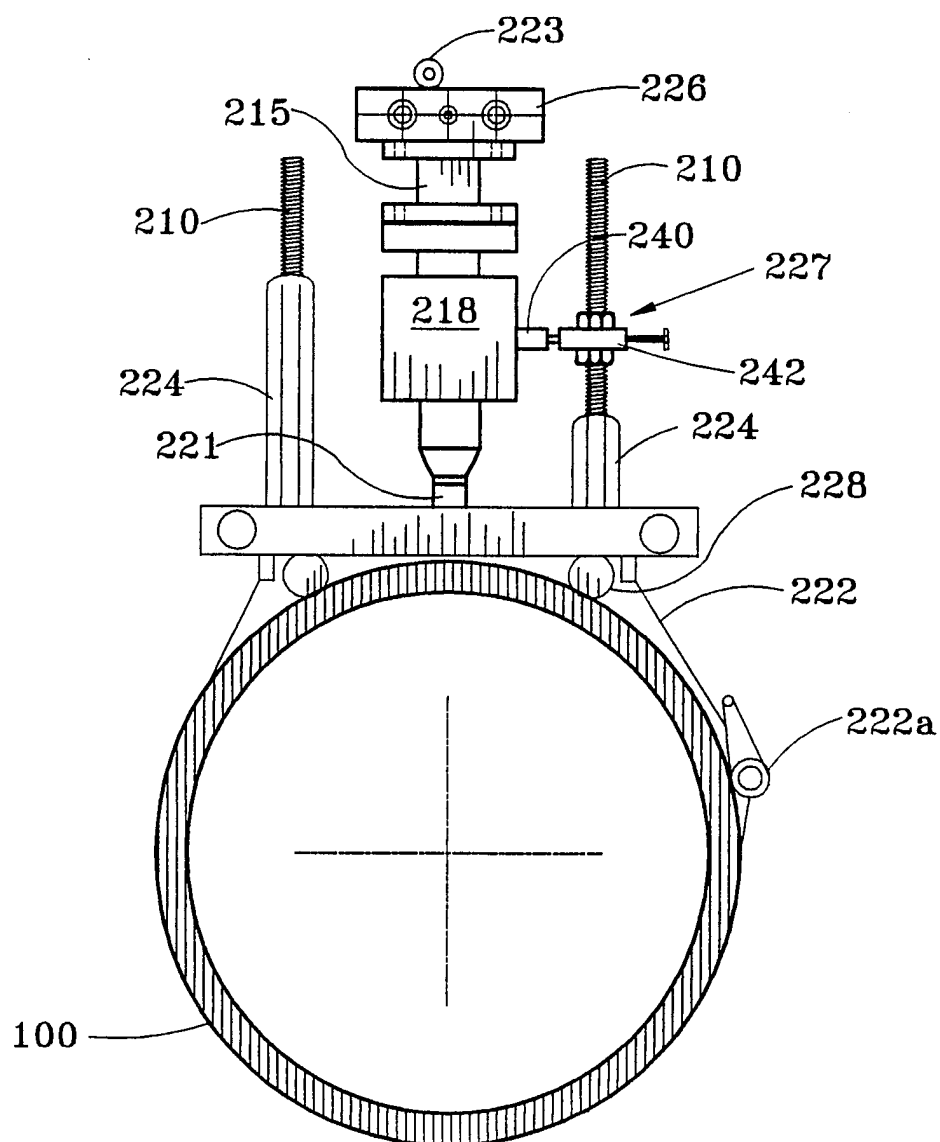


FIG.2



**FIG. 5**

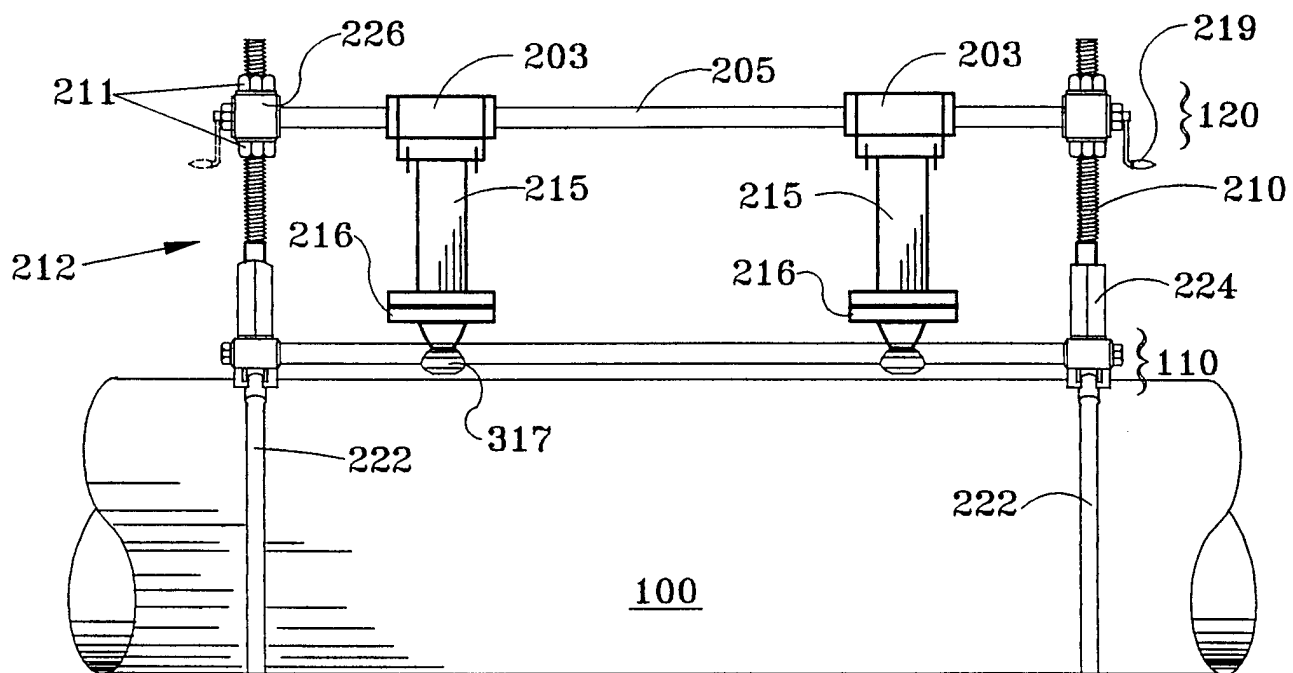


FIG. 6

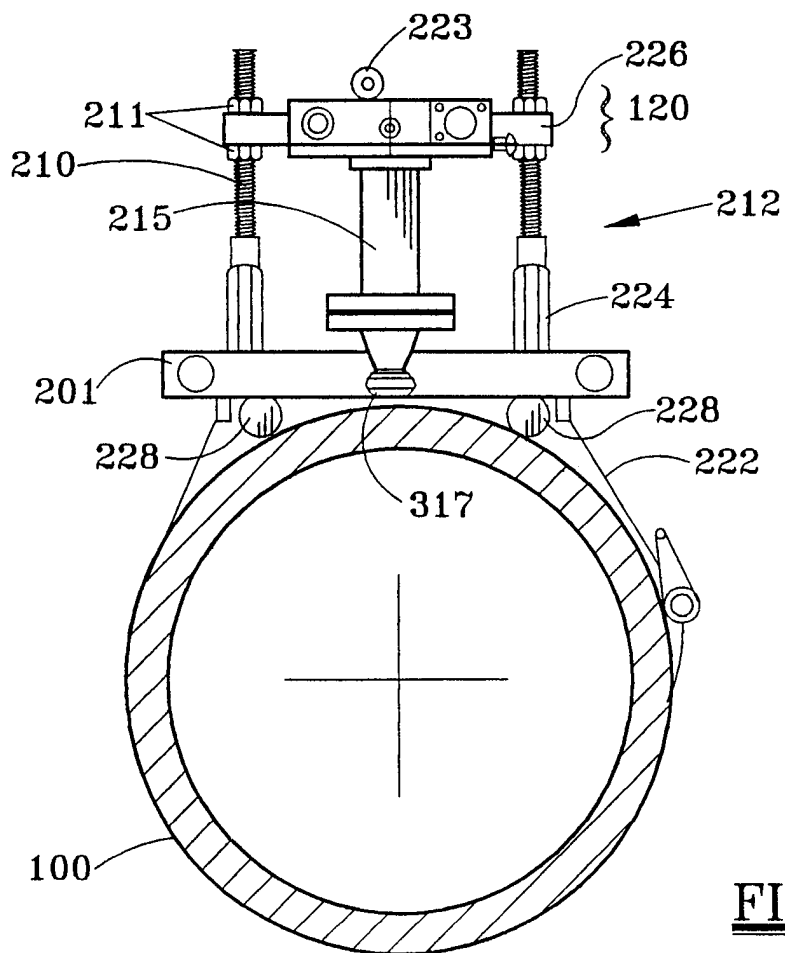
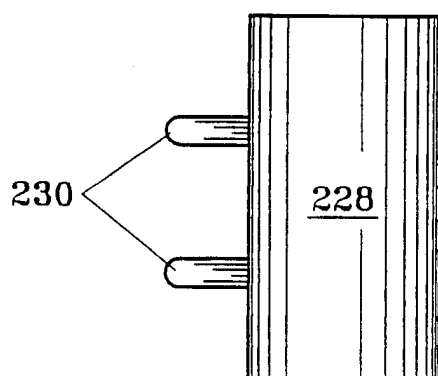
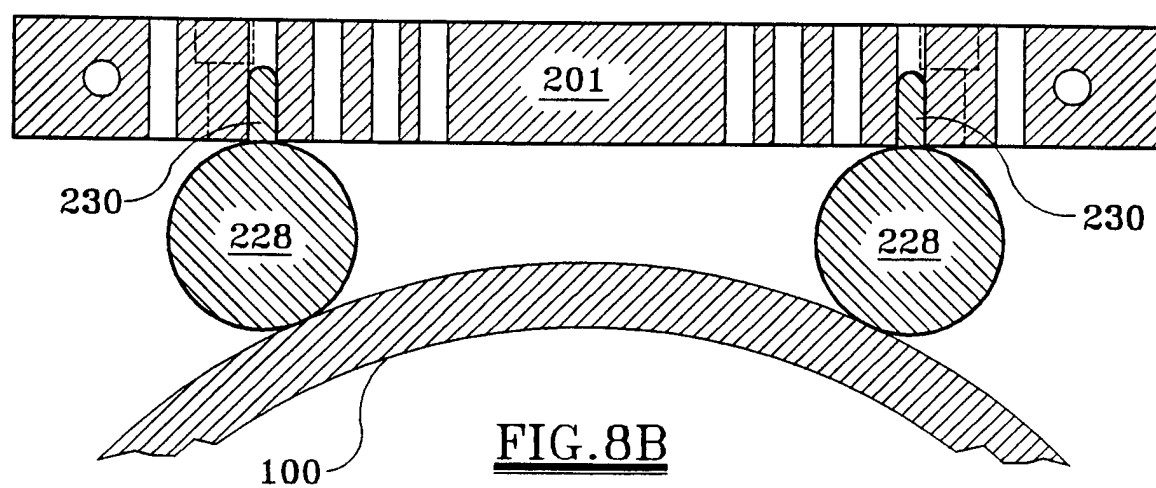
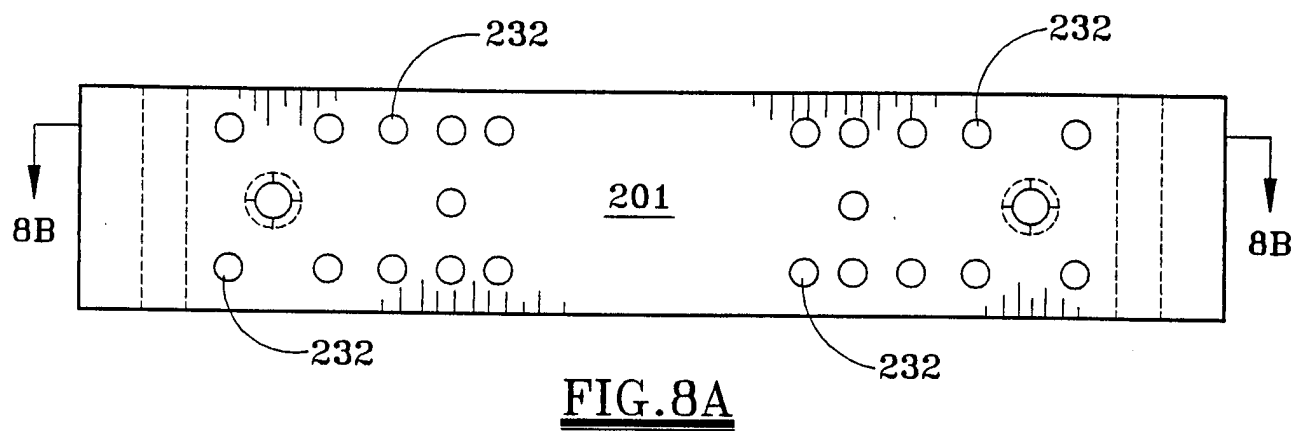


FIG. 7



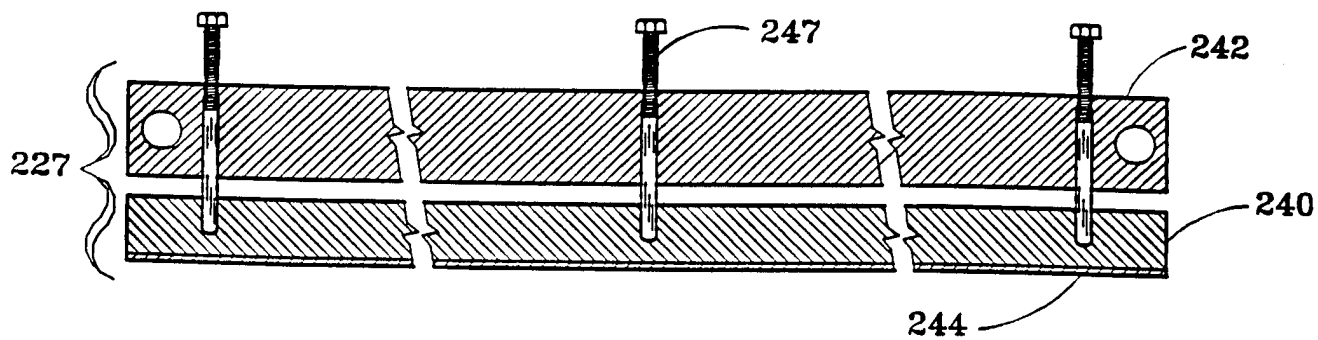


FIG. 9A

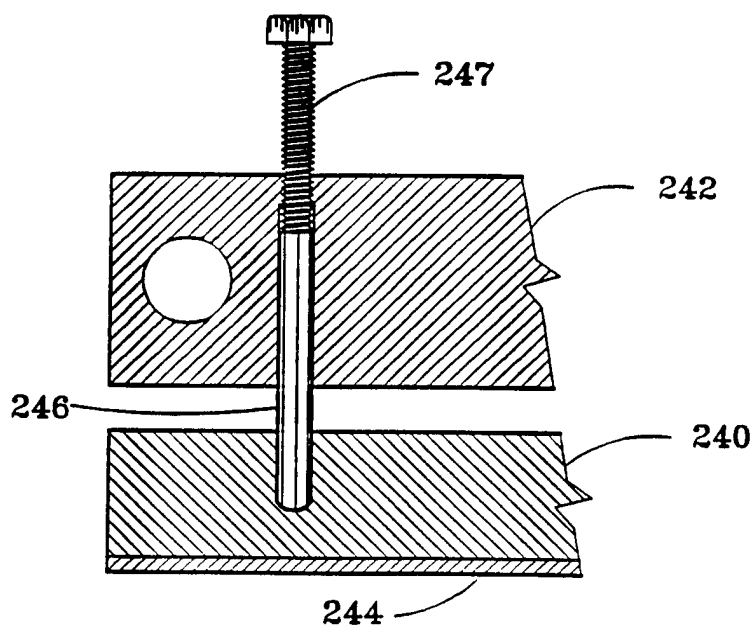


FIG. 9B

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 97/19438

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G01F15/18 G01F15/00 G01F1/66 B23K37/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G01F B23K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 396 814 A (TUTTLE DENNIS H ET AL) 14 March 1995	1, 10, 17
Y	see column 4, line 33 - column 5, line 33; figures 1-3	2-6, 10
Y	US 4 716 271 A (HULSIZER PHILIP N ET AL) 29 December 1987 see column 5, line 11 - column 35 see column 9, line 16 - line 25; figures 1, 2	2-4
Y	PATENT ABSTRACTS OF JAPAN vol. 007, no. 278 (P-242), 10 December 1983 -& JP 58 154621 A (EBARA SEISAKUSHO KK), 14 September 1983, see abstract	5, 6, 10
	--- -/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search

4 March 1998

Date of mailing of the international search report

16/03/1998

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 97/19438

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 064 (P-1685), 2 February 1994 -& JP 05 281006 A (CHOONPA KOGYO KK;OTHERS: 01), 29 October 1993, see abstract; figures 1-6 ---	1,5,6
A	US 5 410 920 A (WESTWICK TODD G) 2 May 1995 see column 6, line 18 - line 41; figures 1,2 -----	2,3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 97/19438

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5396814 A	14-03-95	NONE	
US 4716271 A	29-12-87	NONE	
US 5410920 A	02-05-95	NONE	