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(54) **FLUID FLOW CONDITIONER**

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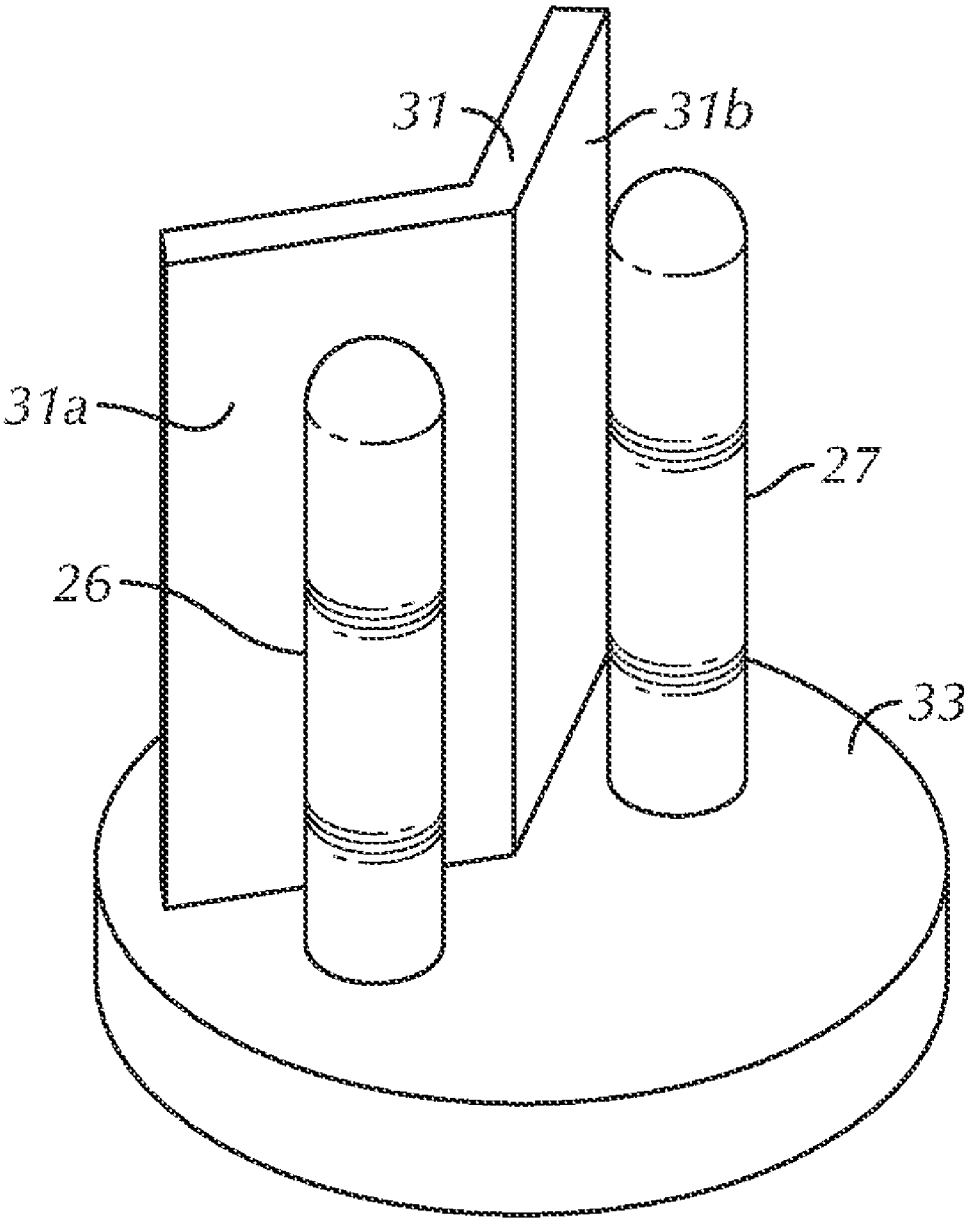
(57) **ABSTRACT**

A device and method for conditioning media flowing within a conduit enabling sensors placed within short straight run distances to measure media flow with improved accuracy employing a thermal flow instrument. A flow conditioner downstream of a media flow measuring transducer has walls that diverge in the flow direction to optimize readings of the media flow from the transducer.



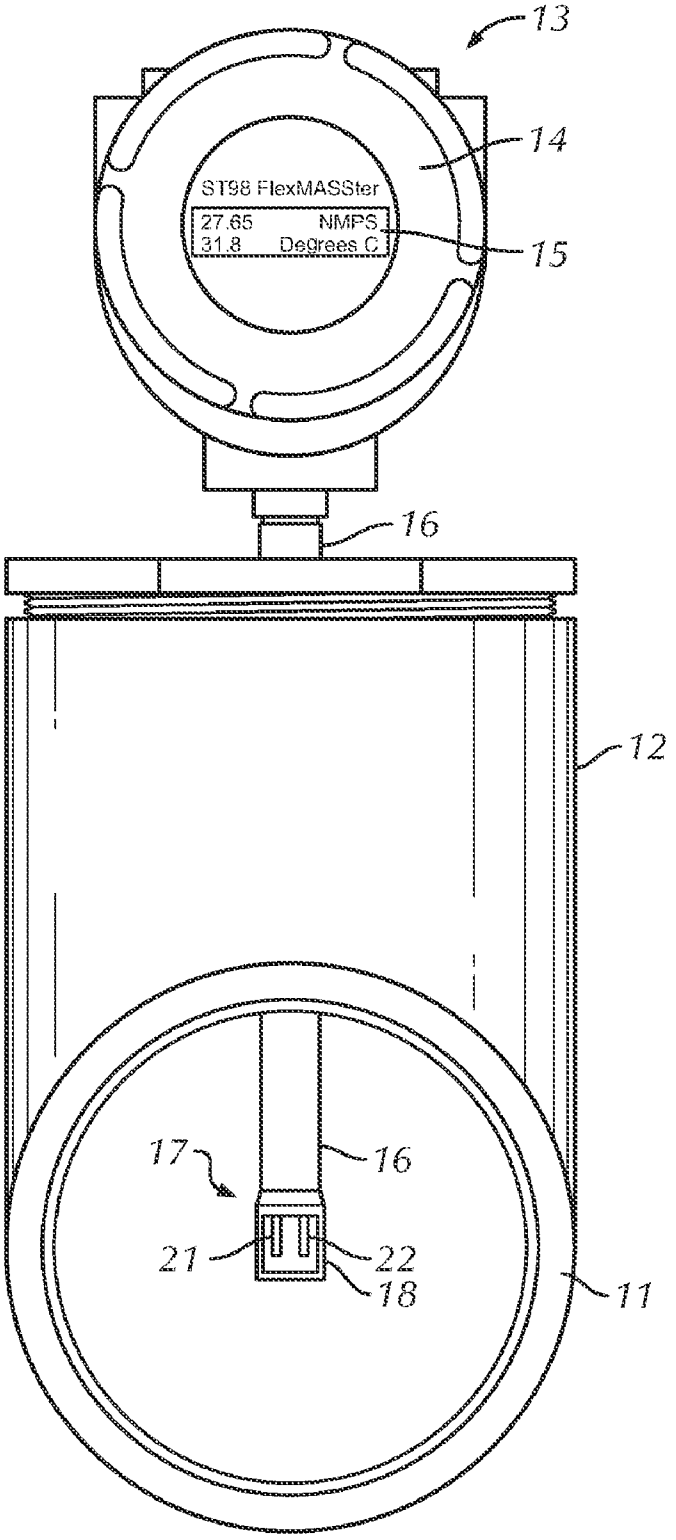


FIG. 1
(Prior Art)

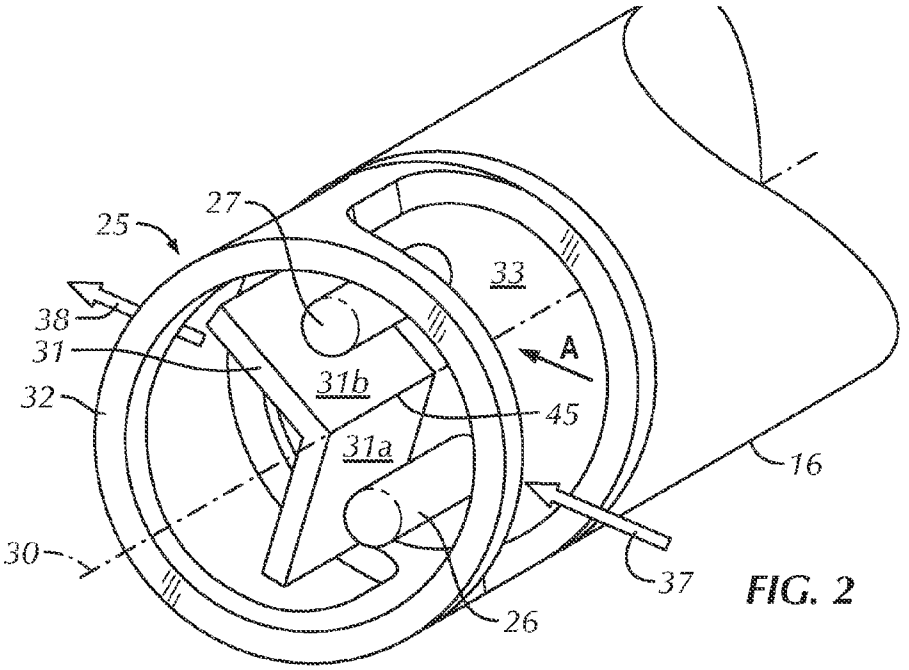

25
27
33
38
31
A
31b
32
45
31a
16
30
37
26

FIG. 2

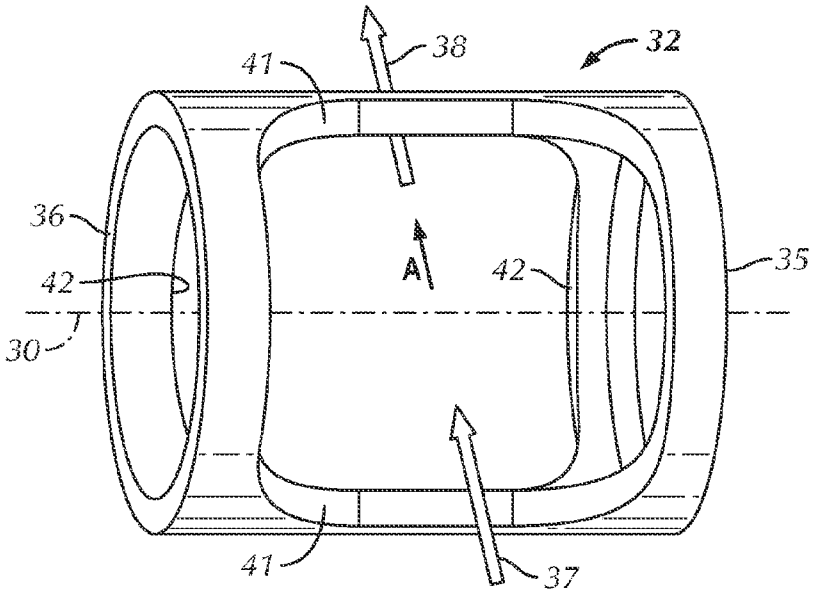

41
38
32
36
A
42
42
35
30
41
37

FIG. 3

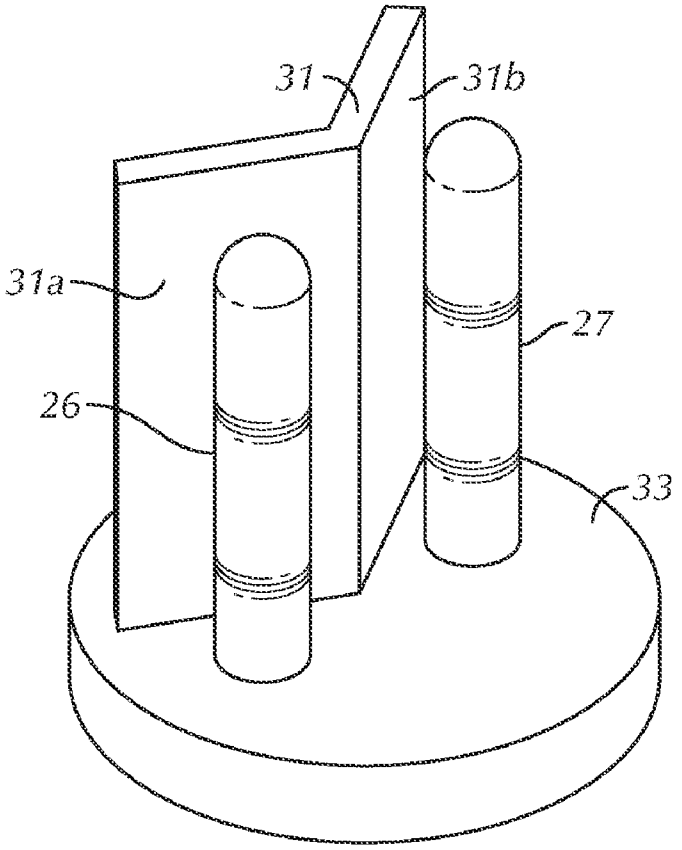

31
31b
31a
27
26
33

FIG. 4

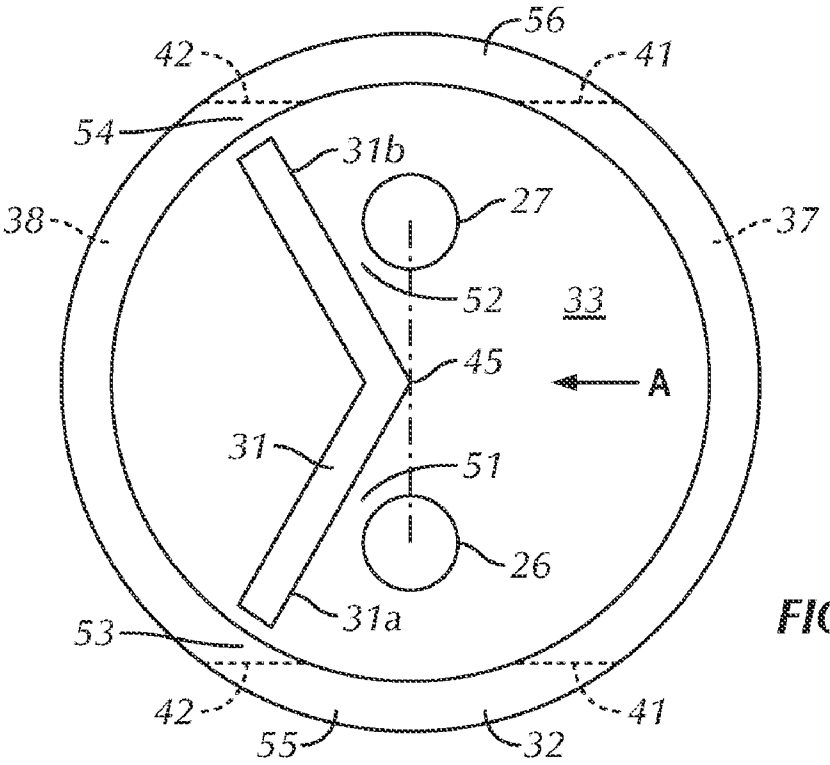

56
42
41
54
31b
27
38
37
52
33
45
A
31
51
26
31a
53
42
41
55
32

FIG. 5

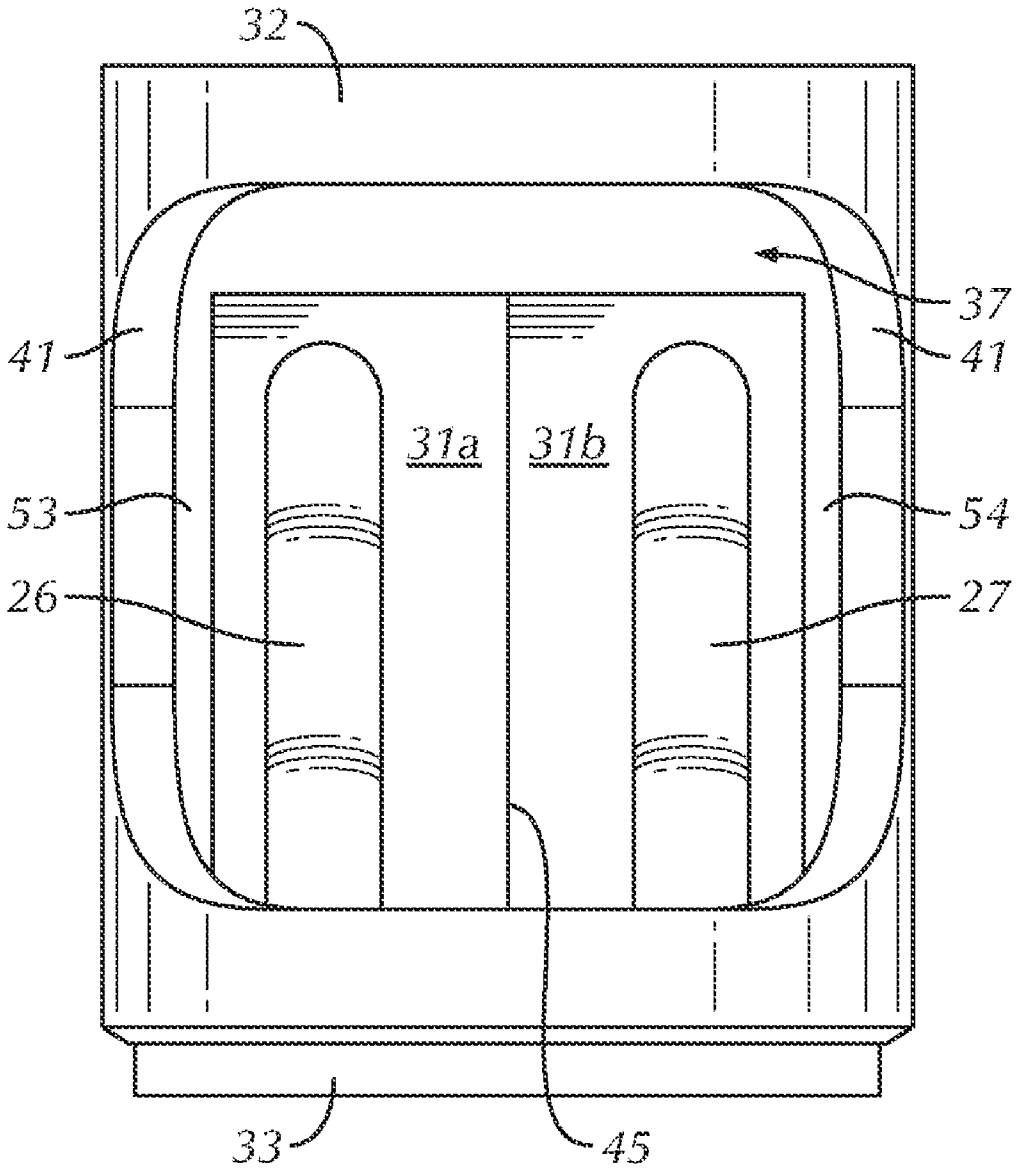


FIG. 6

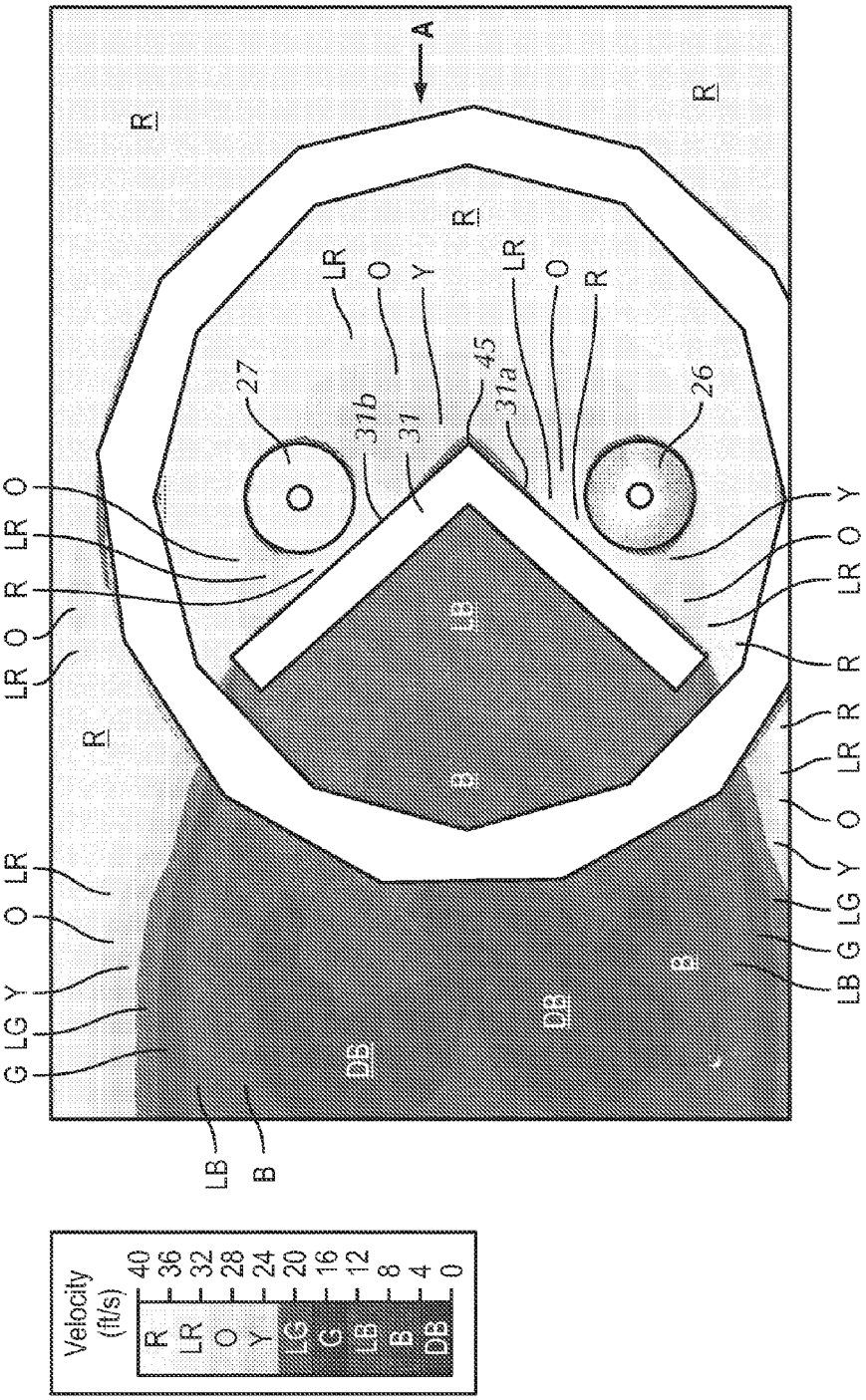

A
R
LR
O
Y
45
31a
31
31b
27
26
LB
B
DB
G LG Y O LR
LB B
LR O R LR O
LR O Y
LR R R
O LR R
LB G LG Y O
Velocity (ft/s)
40 36 32 28 24 20 16 12 8 4 0
R LR O Y LG G LB B DB

FIG. 7

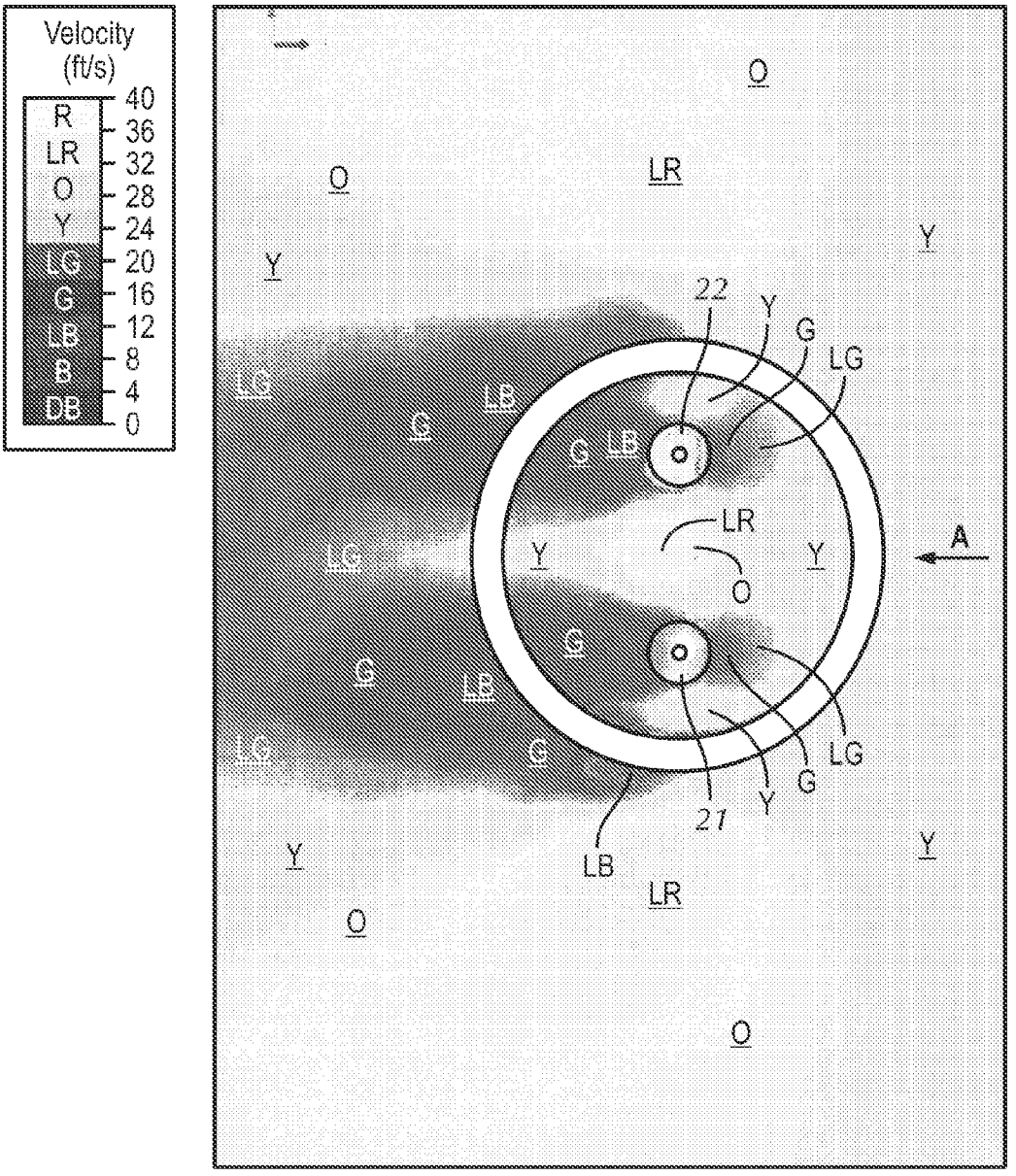


FIG. 8
(Prior Art)

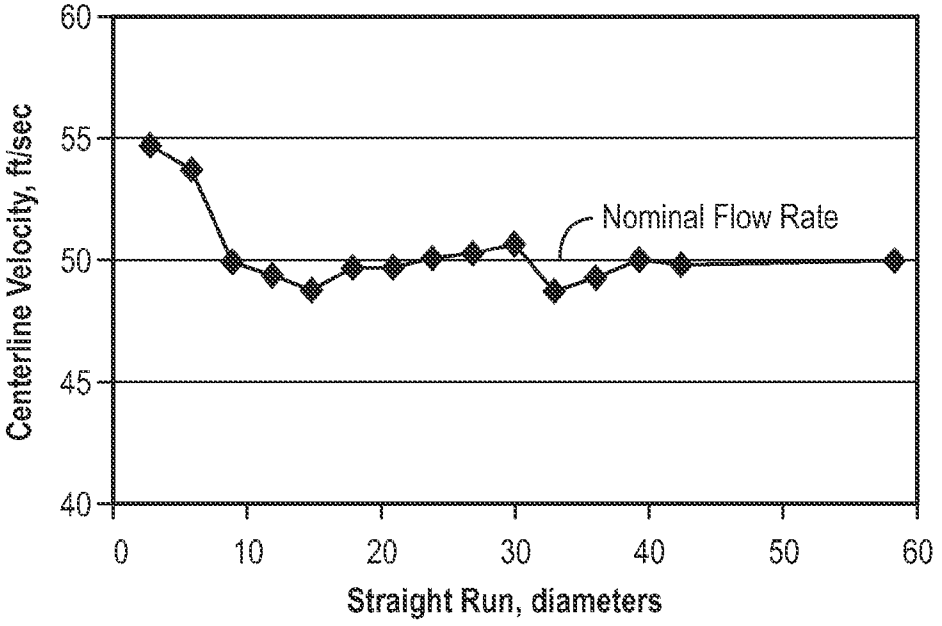

60
55
50
45
40
Centerline Velocity, ft/sec
Nominal Flow Rate
0
10
20
30
40
50
60
Straight Run, diameters

FIG. 9

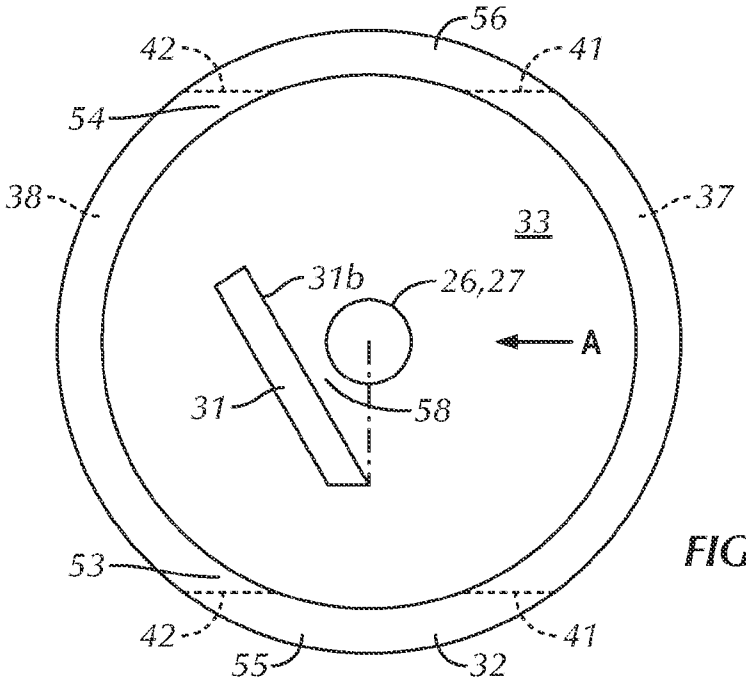

56
42
41
54
38
37
33
31b
26,27
A
31
58
53
42
41
55
32

FIG. 10

FLUID FLOW CONDITIONER

FIELD OF THE INVENTION

[0001] The invention relates generally to devices that condition flowing media within a conduit, and more particularly, to such devices that condition flowing media to enable more accurate readings of thermal flow sensors used to measure the flowing media.

BACKGROUND OF THE INVENTION

[0002] When using thermal flow meters, the accuracy of mass flow rate measurements of media traveling within a conduit can be adversely affected by random and unpredictable turbulence within the flowing media, as well as by the fact that flow rates are not uniform across the conduit cross section. Flow meters typically employ high performance sensing elements that can be uniquely designed for application requirements with precision signal processing and calibration of sensing elements and transmitting electronics. Random turbulence, or non-uniform flow, within the flowing media introduces inconsistencies in the transducer readings.

[0003] Thermal dispersion flow meters are well known and are commonly used to measure the flow of media within a conduit. Thermal technology utilizes the relationship between flow rate and cooling effect for direct measurement of mass flow rate. The media flowing in a conduit affects the temperature of sensing elements and this effect is used to create an electrical signal that can be processed to indicate the flow rate or mass flow rate of the media within the conduit.

[0004] Flow conditioning devices may be used to overcome random turbulence properties that occur in applications where non-ideal upstream flow conditions exist. These turbulence properties may be caused by valves, bends, or elbows, for example, within the conduit, as well as flow rates of the media, and viscosity properties of different types of media. The elements employed by thermal dispersion mass flow meters can suffer accuracy problems due to non-ideal flow conditions in the vicinity of the sensing elements. Such non-ideal flow conditions that exist upstream from the sensing elements can create inaccuracies in the readings obtained from the sensing elements.

[0005] Within the art of flow meters, numerous flow conditioning devices have been taught. Examples of known flow conditioners are those that use bars, perforated plates, tube bundles, or tab structures to condition media to enhance sensor readings.

[0006] One turbulence inducing prior art device is disclosed in U.S. Pat No. 5,780,737. This sensor employs a bar mounted closely upstream from a transducer for the purpose of flow conditioning. The bar generates a predictable vortex stream (turbulence) a short distance upstream of a flow sensing element to counteract the random or unpredictable turbulence that exists within the media flowing through a conduit. The vortex stream generated by the flow conditioning bar is consistent and predictable compared with the non-conditioned turbulence within the flowing media upstream of the bar. Thus, any existing random turbulence within the flowing media is essentially overridden by the turbulence created by the vortex generating bar.

[0007] A completely different type of flow conditioner is shown in U.S. Pat. No. 4,929,088, which includes several radially, or longitudinally, or both, spaced tabs to create a mixing effect as well as conditioning the flow of the media in the conduit.

[0008] In order to measure media flowing within a conduit by means of a thermal flow meter, minimum straight runs of the conduit are typically needed for improved accuracy. In order to achieve optimum performance in industrial flow metering systems, upstream and downstream straight run requirements are typically quoted at about 20 conduit diameters upstream and about 10 diameters downstream. These straight run lengths are typically necessary in order to create a consistent flow profile and allow dissipation of the turbulence in the media that may result from elements such as bends, elbows, and valves in the conduits carrying the media. Implementing straight runs of these lengths is not always easy and sometimes impossible to satisfy in any particular installation. Metering systems with insufficient straight run lengths can suffer somewhat degraded meter accuracy if a consistent flow profile is not able to be developed.

SUMMARY OF THE INVENTION

[0009] The embodiments disclosed herein address some shortcomings in the prior art of measuring flowing media within a conduit. The problems associated with the length of straight run requirements in industrial flow metering for about 20 diameters upstream are addressed by flow conditioners disclosed herein. Embodiments are disclosed for flow conditioning that can be accomplished in substantially shorter straight run lengths than required without using flow conditioners. The embodiments disclosed herein provide methods and systems for conditioning media that flows within a conduit to reduce the impact that less than ideal media flow profile has on transducers used to measure the flowing media, thereby enhancing the accuracy of the transducers.

[0010] An embodiment of the invention provides a flow conditioner that can be used with existing flow measurement systems.

[0011] Another embodiment provides a flow metering method that conditions media flowing within a conduit to provide flow velocities impinging the transducers which are consistent with the nominal media velocity in the conduit.

BRIEF DESCRIPTION OF THE DRAWING

[0012] The purposes, advantages, and features of the invention will be more fully understood from the following detailed description, when read in conjunction with the accompanying drawing wherein:

[0013] FIG. **1** is an end view of a conventional flow meter mounted to a fluid conduit segment;

[0014] FIG. **2** is a perspective illustration of an embodiment of a flow conditioner according to the invention;

[0015] FIG. **3** is an enlarged illustration of an embodiment of the shroud used in the FIG. **2** flow conditioner;

[0016] FIG. **4** show the end cap, the thermowells, and the wedge shaped element of the flow conditioner of the present invention;

[0017] FIG. **5** is an end view of the flow conditioner of FIG. **2**;

[0018] FIG. **6** is a side view of the flow conditioner of FIG. **2**;

[0019] FIG. **7** illustrates a media velocity diagram for a flow metering system similar to the one in FIG. **1** with an embodiment of a flow conditioner in accordance with the invention;

[0020] FIG. **8** illustrates a media velocity diagram for a flow metering system similar to the one in FIG. **1**, without a flow conditioner of the present invention;

[0021] FIG. **9** is a plot of centerline versus straight run velocity in conduit diameters for media flowing in a conduit without the flow conditioner of the present invention; and

[0022] FIG. **10** is an end view, similar to FIG. **5**, showing an alternative embodiment according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0023] According to various embodiments for flow conditioning, the media that flows within a conduit can be either a gaseous or a liquid substance, so the term "fluid" may be used to include both. Therefore, the embodiments described herein should not be seen as limiting and the scope of the invention should be measured as defined by the appended claims. These embodiments generally describe gaseous media flowing within a conduit, but it should be understood that liquid embodiments are also envisioned. Also, the metering systems illustrated in these embodiments are generally thermal flow meters to measure flow of media within a conduit using transducer elements and it should be understood that other measuring elements can also be used with the flow conditioners described herein. Any type of thermal flow metering system may be employed, including differential temperature, differential power, and differential current, for example. It is also envisioned that alterations may be made to the embodiments taught herein to condition the flow of liquid media within a conduit.

[0024] A conventional mass flow meter is illustrated in FIG. **1**. Conduit **11** has T-connector **12** to which flow meter assembly **13** is mounted. The flow meter has head **14** typically containing the electronics of the instrument and having digital readout **15**. Probe **16** extends from head **14** into conduit **11**. At about the center of the conduit is sensor **17** comprising transducers or sensing elements **21** and **22**, which are protected in the media stream by protector **18**. The actual sensing elements reside within the cylindrical elements shown, which are referred to as thermowells. The thermal flow meter shown operates in a known manner.

[0025] FIGS. **2-6** illustrate an embodiment of flow conditioner and sensor **25** formed in a cylindrically shaped device having a longitudinal axis as indicated by centerline **30**. Sensors **26** and **27** are the sensing elements of the thermal flow metering system, similar to assembly **13** in FIG. **1**, which measures flow of a media flowing within a conduit such as conduit **11** in FIG. **1**. An example of such a metering system is model ST98, sold by Fluid Components International LLC of San Marcos, Calif. The metering system shown in FIG. **2** includes a flow conditioner comprised preferably of wedge element **31** and shroud **32** that conditions the flow of the media in the vicinity of flow sensing transducers **26** and **27** in order to provide enhanced mass flow readings of the flowing media. The transducers are typically thermowells containing thermal sensing elements. Shroud **32** is mounted on cap **33** at the distal end of probe **16**. The shroud surrounds wedge **31** and sensors **26** and **27**. The distal end of the metering system comprising sensors **26** and **27**, wedge element **31**, and shroud **32**, is inserted into a conduit (not shown in this figure) in a manner that allows media to continue to flow through the conduit. The sensor elements of the flow meter are at the distal end of the cylindrical probe **16** which project through the wall of the conduit in a conventional manner and are generally positioned at approximately the center of the conduit, as shown in FIG. **1**.

[0026] FIG. **3** is an enlarged perspective view of shroud **32**. Shroud **32** and cap **33** of cylindrical probe **16** may be secured together by any suitable means, such as as welding, or the use of an appropriate adhesive, among others. Either end **35** or **36** of the shroud may be secured to the cap since the shroud is shown here as being symmetrical. However, there is no requirement that the shroud be symmetrical. Cap **33** may be formed with a groove to receive an appropriately shaped annular rim of the shroud, or either or both the cap and the shroud may be shaped in any desired fashion to facilitate them being secured together. Input opening **37** is defined by peripheral rim **41**, while peripheral rim **42** defines output opening **38**. From this view it can be seen that openings **37**, **38** are diametrically opposed and enable passage of flowing media therethrough, even with wedge element **31** and sensors **26**, **27** projecting therein. The media flows through openings **37**, **38** in the shroud in the direction of arrow A, as seen in FIGS. **2** and **3**. Wedge element **31** is mounted within shroud **32** such that it is downstream of sensors **26**, **27** in the direction of the flowing media. Alternatives to the shape of the shroud will be discussed below with respect to FIG. **5**.

[0027] The sensor and flow conditioner **25** illustrated in FIG. **2** could be combined with an industry standard ST98 flow meter, previously identified, with the added components of flow conditioner elements **31** and **32**. The ST98 instrument is an insertion style, thermal dispersion mass flow meter that measures the temperature difference between elements, here sensors **26**, **27**. In the conventional manner for thermal flow instruments, one of the elements is a reference sensor and the other is an active, or heated, sensor. Flowing fluid dissipates heat from the active sensor and the differential temperature, in relation to the current or power applied to the active probe, for example, with the conventional electronics of such a system, converts these data points to a measure of mass flow of the fluid in the conduit.

[0028] Stated another way, shroud **32** and wedge element **31** are components that can be configured with an industry standard metering system, such as the ST98 thermal dispersion mass flow meter. This metering system is identified for example only and the flow conditioner of the invention can be employed with a variety of thermal flow measurement systems.

[0029] Wedge element **31** as shown in FIGS. **2**, **4**, and **5**, when viewed in the direction of longitudinal axis **30**, has a substantially V-shape with walls **31***a*, **31***b* arranged to diverge from apex **45** in direction A of the flowing media. The apex of V-shaped element **31** is shown essentially equidistant from sensors **26**, **27** and extends at least partially between the sensors (see FIG. **5**). The specific configuration and orientation of the embodiment shown in FIG. **2** is illustrative of one embodiment and should not be viewed as limiting the invention. For example, the size and/or shape of wedge element **31** can be altered, and this will be addressed below.

[0030] In differing embodiments, diverging walls **31***a*, **31***b* can be arranged or positioned in various configurations. The diverging walls can be formed to be various heights either relative to the size and height of upstream opening **37**, to shroud **32**, or to the projecting lengths of thermowells **26**, **27**. Height, as discussed here, relates to a distance in the longitudinal direction from cap **33** of probe **16**, and an embodiment is shown clearly in FIG. **6**. It may also be referred to as

"length." Diverging walls **31***a*, **31***b* can be formed to have a height nearly as high as opening **37** in the direction of longitudinal axis **30**. In the particular embodiment shown, wedge **31** extends in length about 15% farther from cap **33** than do sensors **26**, **27**. Thus, the length of wedge **31** may be about 0.75 inch and the sensors could be about 0.66 inch in a typical installation. However, the length could be shorter or longer than the sensors and still function effectively, and the sensors and wedge element can be longer or shorter, depending upon the size of the conduit, or upon the type of media being measured.

[0031] The media flowing in the direction of arrow A is forced to impact walls **31***a*, **31***b* and move around wedge element **31**, as shown graphically in FIG. **7**.

[0032] One rationale for measuring the length of walls **31***a*, **31***b* in the direction of longitudinal axis **30** to be in relation to the height of sensors **26**, **27**, is that the sensing or heated areas within the thermowells is normally somewhere near the linear center of the probe in the direction of longitudinal axis **30**. A good deal of variance could then be allowed within embodiments using thermal transducers in forming limits of the height of walls **31***a*, **31***b* in the direction of longitudinal axis **30**. These variances can be employed for embodiments using different media and in different circumstances to enhance the effectiveness of flow conditioner **25** in creating consistent flow velocities in the vicinity of sensors **26**, **27**.

[0033] As shown in FIGS. **5** and **7**, wedge element **31** is mounted downstream of sensors **26**, **27** such that the flowing media will pass through opening **37** and encounter the sensors before impacting upon walls **31***a*, **31***b* of wedge element **31**. The presence of the diverging walls just downstream from the sensors dramatically increases the velocity of the media observed in the vicinity of and surrounding the sensors, compared to similar arrangements for such probes without wedge element **31**. This phenomenon will be further discussed below with respect to FIG. **7**.

[0034] FIG. **8** illustrates velocity patterns that have been observed for a prior art flow metering system, such as that shown in FIG. **1**, having thermal sensors **21**, **22** but without flow conditioner **25**. The nominal flow at the center of the conduit, in this example, is about 25 feet per second. The legend for the velocity pattern is shown in the chart to the left of the velocity diagram, and the following describes the flow velocity with respect to the legend. LR is areas having a flow rate of about 34.5 feet per second; 0 is areas having a flow rate of about 30.7 feet per second; Y is areas with a flow rate of about 25-30 feet per second, that is, approximately nominal flow velocity; LG is areas with a flow rate of about 23 feet per second, near nominal flow velocity; G is areas with a flow rate of about 19 feet per second; LB is about 10 feet per second; and B is areas with a flow rate of about 4 to about 8 feet per second. As clearly evident from FIG. **8**, the flow rates are much higher at a distance from sensors **21**, **22**, and there is substantially no, or insignificant, 25 fps flow in contact with the sensor elements. In fact the flow rates in contact with sensors **21**, **22** are not at all consistent with the nominal flow of 25 fps, and the average velocity of the media in contact with the sensors is well below the nominal flow rate. Immediately upstream of sensors **21**, **22**, the velocities are shown as about 19 fps and immediately downstream of these sensors the velocities of the media are all the way down to 8 to 10 fps. The low rate between the sensors is actually higher than the nominal flow rate, but that flow area is not in contact with the sensors The flow velocities in close vicinity of sensors **21**, **22** are not truly representative of the nominal flow rate of the media in the conduit, which is the flow with respect to which the flow meter is intended to measure. Therefore, the mass flow rate detected by sensors **21**, **22** may not fairly represent what is actually happening within the conduit.

[0035] FIG. **7** illustrates velocity patterns that have been observed for a flow metering system, such as that shown in FIG. **2** having thermal sensors **26**, **27**, except that in FIG. **7** flow conditioner **25** is included with flow meter assembly **13**.

[0036] In this case the nominal flow rate is about 40 feet per second. The legend for the velocity pattern will now be described, with reference to the chart to the left of the velocity diagram. R is areas having a flow rate of about 40 feet per second or higher; LR is areas having a flow rate of about 33 feet per second; 0 is areas having a flow rate of about 28 feet per second; Y is areas with a flow rate of about 24 feet per second; LG is areas with a flow rate of about 20 feet per second; G is areas with a flow rate of about 16 feet per second; LB is areas with a flow rate of about 8-12 feet per second; and B is areas with a flow rate of between 0 and about 4 feet per second. It can be clearly seen from FIG. **7** that the flow rates in the vicinity of sensors **26**, **27** are much more consistent with the nominal flow rate upstream of flow metering system **13** than was observed for the flow in the metering system of FIG. **8**. The flow rates in contact with sensors **26**, **27** range from higher than 40 fps down to about 26 fps. Since both probes are significantly partially surrounded by media flow at or above about 40 fps, the readings of the flow meter will be much more accurate than is the meter of FIG. **8**. These flow rates in the close vicinity of sensors **26**, **27** are very much consistent with the nominal flow rate in the conduit.

[0037] In order to obtain the advantageous flow around the sensors that is depicted in FIG. **7**, some exemplary dimensions are here set forth. The angle of apex **45** between the sides of wedge **31** can range from about 90°-140°, and preferably about 120°. The distance between walls **31***a*, **31***b* and respective sensors **26**, **27** (gaps **51**, **52** in FIG. **5**) is about 0.015-0.045 inch, preferably about 0.030 inch. From FIG. **5** it can be seen that apex **45** is shown at about the centerline between sensors **26**, **27**. For a 120° apex, this is preferred, but not exactly mandatory. For other apex angles, the position of the apex with respect to the centerline between the sensors will vary, it being preferable to maintain the distance from walls **31***a*, **31***b* to the sensors generally in the 0.030 in range.

[0038] While the foregoing discussion relates to the symmetric arrangement of walls **31***a*, **31***b*, apex **45**, and thermowells **26**, **27**, those relationships are not required for embodiments of the invention to function in a useful manner. The relationships between one of the wedge walls and its adjacent thermowell is primarily relevant only for the active sensor. The wedge wall adjacent to the reference sensor is not nearly as important. Thus, the apex could be moved up or down (with respect to the FIG. **5** orientation), as long as the venturi-like effect is maintained with respect to the sensor that is the active or heated one. Further, if the apex angle is increased to greater than about 120°, the apex might reside left of a tangent line from thermowell **26** to thermowell **27**. Conversely, with a sharper angle, less than about 120°, the apex could project beyond the right tangent line from the thermowells.

[0039] As can be seen from FIG. **7**, a venturi-like effect is created as the media flows around sensors **26**, **27** and is confined by wedge walls **31***a*, **31***b*. This has the effect of at least partially surrounding the sensor element with the media being measured flowing at or near the nominal flow rate, or at

least averaging the nominal flow rate. By actual measurements, the flow velocity through gaps **51**, **52** is greater than the nominal flow rate, thus resulting in the average being near the nominal flow rate.

[0040] FIG. **9** shows how unpredictably varied the centerline velocity of flow is from about 5 to about 18 diameters after a disturbance source, such as a bend, elbow, or valve, for example. It is very easy to understand that a thermal flow transducer that is inserted into the conduit at any point less than about 20 diameters downstream from the cause of unstable flow can provide inaccurate readings. Certainly there is much greater heat dissipation in the active sensor element at three to five diameters, where the flow rate is about 54, fps while the nominal flow rate is 50 fps and settles in to that velocity at about 20 diameters.

[0041] Referring again to FIGS. **2** and **7**, in conjunction with the conventional sensor in FIG. **8** the improvements observed using a conventional flow meter with a flow conditioner comprising wedge element **31** and shroud **32** is a result of increased velocity of the flowing media in the vicinity of sensors **26**, **27** after passing through opening **37** in shroud **32**. The diverging walls **31***a*, **31***b* of the wedge element forces flowing media to move around the wedge element and to enhance the media velocity through gaps **51** and **52**. Flowing media is forced to move either above the wedge element, or through crevices **53**, **54** between the distal ends of walls **31***a*, **31***b* and the sides of shroud **32**, after impacting walls **31***a*, **31***b*, resulting in the average velocity of the flowing media in the vicinity of the sensors being maintained at about the nominal velocity. Because flow conditioner **25** makes the media flow around the thermowells predictable and consistent, inconsistencies in the velocity of the flowing media around sensors **26**, **27** is reduced, thereby enhancing the accuracy of the readings derived from the sensors.

[0042] It has been found that sides **55**, **56** of the shroud, coupled with crevices **53**, **54** (FIG. **5**) combine to increase flow around sensors **26**, **27**. Although they can vary, it has been found that by making crevices **53**, **54** to be about 0.0120 inch, the meter has consistent and accurate output. Sides **55**, **56** are shown to have an included arc of about 55°, and they could range between about 25° and about 75°.

[0043] In FIG. **5** the shroud is shown with input opening **37** and output opening **38** while the spacing between sides **55**, **56** and the distal ends of the walls **31***a*, **31***b* is, in some embodiments, beneficial to the accuracy of the meter with which the low conditioner functions, the shape and size of output opening **38** is not in itself significant. Once the media has encountered thermowells **26**, **27** and walls **31***a*, **31***b*, and crevices **53**, **54**, it is not relevant how the media egresses from the flow conditioner.

[0044] As an alternative embodiment, wedge element in combination with the sensors (FIG. **4**) provides improved mass flow readings, even without the shroud. This structure is a simplified and effective flow conditioner. The combination with shroud **32** (FIGS. **2** and **5**) provides even greater degrees of accuracy for the meter. From the physical standpoint, shroud **32** protects the rather delicate sensor elements from being damaged by impurities and debris that may be flowing with the media in the conduit. Additionally, the shroud has a synergistic effect on the accuracy of the mass flow readings for the meter equipped with wedge **31**, because it affects the flow of media through the shroud, It has also been found that the shroud alone, without the wedge, improves the meter accuracy. This is yet another alternative embodiment. The flow conditioner, whether it employs the wedge only with the thermowells, the shroud only with the thermowells, or combines the wedge and the shroud with the thermowells, tends to moderate upstream disturbances.

[0045] In some instances thermals flow metering systems employ a single sensor, which operates on a time share basis. That is, instead of having one heated, or active sensors, and one non-heated, or reference, sensor, the single sensor switches between being the heated sensor and being the reference sensor. In such an embodiment only a single diagonal wall would replace the wedge element and would be arranged in close proximity to the thermowell containing the sensor. That proximity is discussed in greater detail below. Such an embodiment is shown in FIG. **10**. In this embodiment, the sensors in thermowells **26**, **27** are combined into a single, time-shared sensor element. Only a single vane **31** having a wall **31***b* adjacent to the thermowell is required. When the sensor is the active, or heated, sensor, the media flow through gap **58** increases the velocity around at least a portion of the thermowell. As stated previously, the flow around the thermowell when it is functioning as the reference sensor is not of particular significance because it represents the ambient temperature of the media and is not a measure of thermal dissipation. Other than operating in a time shared manner, the FIG. **10** embodiment functions in substantially the same way as the other embodiments presented herein. The angle of wall **31***b* with respect to the media flow direction A is about 45°-70°.

[0046] The sensors are mounted to and extend through cap **33** in a conventional manner. Wedge **31** may be mounted to cap **33** by any suitable means, such as welding, brazing, or through the use of a suitable adhesive. Similarly, shroud **32** is also secured to cap **33**. It is also possible to mold or machine the cap and shroud together or even the cap, shroud and wedge together.

[0047] It is contemplated that the media with which the structure of the embodiments of the invention that are shown and suggested here can be any type of fluid, whether a liquid or a gas. Further, while wedge **31** is shown having an open V-shape, it could be a filled in wedge, giving it a delta shape, or it could be arcuate, either convex or concave. In other words, the downstream shape of wedge **31** is generally not significant. It is the shape and position of walls **31***a*, **31***b*, interacting primarily with thermowells **26**, **27**, and shroud **32**, that provides the most advantageous function of the embodiments of the invention. While the wall or walls of wedge **31** are shown to be continuous, they could function as necessary for the embodiments contemplated even if they were formed as a screen, or with a plurality or a multiplicity of holes, or with slots. The media would flow over such non-continuous surfaces sufficiently to be efficacious.

What is claimed is:

1. A fluid flow conditioner device for use with a thermal flow instrument having at least a pair of spaced parallel thermal flow thermowells having sensing elements therein configured to be arranged in the media flow in a conduit, the device comprising;

a wedge shaped element arranged a predetermined distance downstream from said thermowells, said wedge shaped element having at least a pair of walls that diverge in the flow direction;

a shroud element partially encompassing said wedge shaped element and said thermowells, said shroud having an upstream opening therein, the upstream opening

being formed to permit the media to flow into said shroud and to impinge upon said thermowells and said wedge shaped element.

2. The device of claim **1**, wherein said shroud element is formed with opposing, space walls defining the upstream opening and wherein said diverging walls of said shaped element have distal ends that are spaced from said spaced walls of said shroud downstream of said thermowells by a predetermined distance.

3. The device of claim **1**, wherein said thermowells and said wedge shaped element extend substantially coextensively into the interior of said shroud.

4. The device of claim **1**, wherein said pair of walls diverge from an apex line defined by the diverging walls, the pair of diverging walls that meet at the apex forming an angle in the range of 90°-140° downstream in the flow direction.

5. The device of claim **4**, wherein the apex line is normal to the flow direction and is substantially located between said thermowells.

6. The device of claim **1**, wherein at least one of said thermowells includes a heated sensor and the other includes a reference sensor, said heated sensor thermowell being spaced from a respective one of said diverging walls by a predetermined distance.

7. A method for conditioning media flowing in a flow direction within a conduit having at least a pair of spaced parallel thermal flow thermowells having sensing elements therein and arranged in the media flow in the conduit, the method comprising:

diverging the media as it flows past the thermowells by means of a wedge shaped element having a pair of diverging walls positioned downstream in the flow direction from the thermowells; and

channeling the flowing media around and past the wedge shaped element and the thermowells by means of a shroud partially surrounding the wedge shaped element and the thermowells, the shroud being formed with an opening upstream from the thermowells in the flow direction.

8. The method of claim **7**, wherein the shroud is formed with opposing, spaced walls defining the upstream opening, and further comprising positioning the pair of diverging walls of the wedge shaped element such that the pair of diverging walls end adjacent to and spaced from the spaced walls of the shroud by a predetermined distance.

9. The method of claim **7**, wherein diverging the media is accomplished by a pair of diverging walls which form a apex from which the pair of walls diverge, wherein the apex is formed at upstream ends of the pair of diverging walls in the flow direction and the apex has an angle in a range of 90°-140° facing downstream in the flow direction.

10. The method of claim **9**, and further comprising providing the thermowells spaced by a predetermined distance from the diverging walls.

11. The method of claim **7**, wherein the wedge shaped element has generally a V-shape.

12. The method of claim **7** wherein the wedge shaped element has generally a delta shape.

13. A fluid flow conditioner device for use with a thermal flow instrument having at least a pair of spaced parallel thermal flow thermowells having sensing elements therein configured to be arranged in the media flow in a conduit, the device comprising:

a wedge shaped element arranged a predetermined distance downstream from said thermowells, said wedge shaped element having at least a pair of walls that diverge in the flow direction.

14. The device of claim **13**, and further comprising a shroud element partially encompassing said wedge shaped element and said thermowells, said shroud element having passageways therethrough to enable the media to flow through while encountering said wedge shaped element and said thermowells.

15. The device of claim **13**, wherein said pair of walls diverge from an apex line defined by the diverging walls, the pair of diverging walls that meet at the apex forming an angle in the range of 90°-140° downstream in the flow direction.

16. The device of claim **15**, wherein the apex line is normal to the flow direction and is substantially located between said thermowells.

17. The device of claim **13**, wherein at least one of said thermowells includes a heated sensor and the other includes a reference sensor, said heated sensor thermowell being spaced from a respective one of said diverging walls by a predetermined distance.

18. A fluid flow conditioner device for use with a thermal flow instrument having at least one thermal flow thermowell having a sensing element therein configured to be arranged in the media flow in a conduit, the device comprising:

a wall element arranged a predetermined distance downstream from said thermowell, said wall element being oriented diagonally with respect to the flow direction; and

a shroud element partially encompassing said wall element and said thermowell, said shroud element having an upstream opening therein, the upstream opening being formed to permit the media to flow into said shroud and impinge upon said thermowell and said wall element.

19. The device of claim **18**, wherein said wall element is arranged at an angle in the range of 45°-70° with respect to the flow direction.

20. A fluid flow conditioner device for use with a thermal flow instrument having at least a pair of spaced parallel thermal flow thermowells having sensing elements therein configured to be arranged in the media flow in a conduit, the device comprising:

a shroud element partially encompassing said thermowells, said shroud element having an upstream opening therein configured to permit media to flow into said shroud and impinging upon said thermowells.

21. The device of claim **20**, and further comprising at least one wall member adjacent to and spaced from at least one said thermowell at an angle of 45°-70° with respect to the media flow direction.

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