



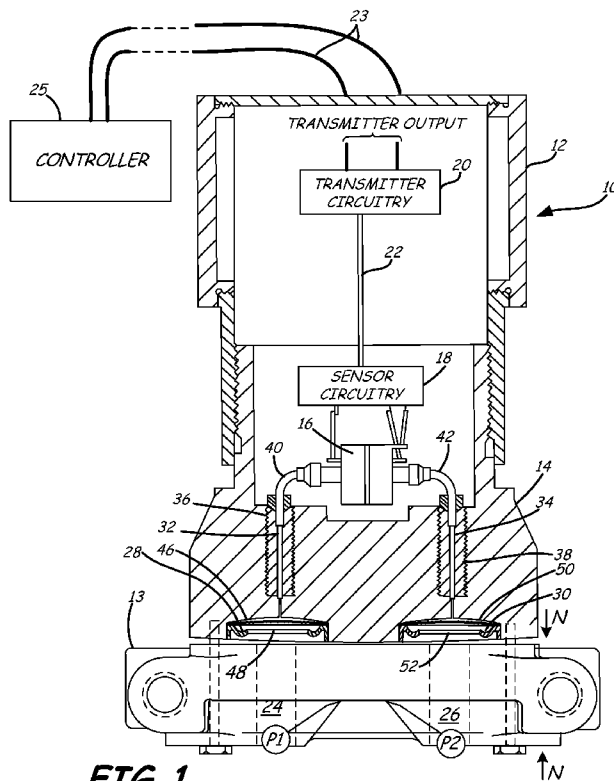
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(54) Title: PRESSURE TRANSMITTER FOR USE IN INDUSTRIAL PROCESS CONTROL SYSTEM



(57) Abstract: A pressure transmitter (10) for measuring a pressure of a process fluid in an industrial process, includes a pressure sensor (16) having an output related to an applied pressure. Measurement circuitry (18,20) coupled to the pressure sensor (16) is configured to provide a transmitter output related to sensed pressure. A pressure coupling face (60) having an opening (48,52) therein is arranged to transfer the applied pressure to the pressure sensor (16). A pressure coupling flange (13) having a flange face (62) abutting the pressure coupling face (60) is configured to convey the process fluid to the opening (48,50) of the pressure coupling face (60). Features are provided to control distribution of a loading force across the pressure coupling face and the flange face.

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AMENDED CLAIMS

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1. A pressure transmitter for measuring a pressure of a process fluid in an industrial process, comprising:

a pressure sensor having an output related to an applied pressure;

measurement circuitry coupled to the pressure sensor configured to provide a transmitter output related to the applied pressure;

a pressure coupling face having an opening therein arranged to transfer the applied pressure to the pressure sensor; and

a pressure coupling flange having a flange face abutting the pressure coupling face configured to convey the process fluid to the opening of the pressure coupling face; and

wherein at least one of the pressure coupling face and the flange face is curved to protrude in a direction toward another of the pressure coupling face and the flange face such that, application of a mounting force to mount the pressure coupling face to the pressure coupling flange causes the curved one of the pressure coupling face and the flange face to deform to conform to a shape of the other of the pressure coupling face and the flange face.

2. The pressure transmitter of claim 1 including an attachment mechanism configured to apply a mounting force between the pressure coupling flange and the planar pressure coupling face.

3. The pressure transmitter of claim 2 wherein a sufficient mounting force urges the at least one of the pressure coupling face and the flange face to conform to the other of the at least one of the pressure coupling face and the flange face.

4. The pressure transmitter of claim 2 wherein the curvature causes the mounting force to be substantially evenly distributed across an area of an interface between the pressure coupling face and the flange face.

5. The pressure transmitter of claim 1 wherein the at least one of the pressure coupling face and the flange face comprises the flange face.

6. The pressure transmitter of claim 1 the wherein at least one of the pressure coupling face and the flange face comprises the pressure coupling face.

7. The pressure transmitter of claim 1 wherein the at least one of the pressure coupling face and the flange face comprises the flange face and the pressure coupling face.
8. The pressure transmitter of claim 2 wherein the at least one of the pressure coupling face and the flange face is substantially planar when loaded with the mounting force.
9. The pressure transmitter of claim 2 wherein the curve is in a direction of the mounting force applied to the at least one of the pressure coupling face and the flange face.
10. The pressure transmitter of claim 9 wherein the mounting force is applied proximate edges of the at least one of the pressure coupling face and the flange face.
11. The pressure transmitter of claim 10 wherein the attachment mechanism is arranged proximate each of four corners of the flange face and the pressure coupling face.
12. The pressure transmitter of claim 11 wherein the attachment mechanism comprises four bolts.
13. A method of coupling a pressure transmitter for measuring a pressure of a process fluid to an industrial process, comprising:
 - receiving an applied pressure at a pressure sensor in the pressure transmitter;
 - coupling a pressure coupling flange having a flange face to a pressure coupling face of the pressure transmitter, wherein the flange face abuts the pressure coupling face, the pressure coupling flange configured to convey a process fluid to an opening of the pressure coupling face; and
 - providing a curvature to at least one of the pressure coupling face and the flange face, the curvature deforming to conform to another of the pressure coupling face and the flange face when mounting force is applied to mount the pressure coupling face to the flange face.

14. The method of claim 13 applying a mounting force between the pressure coupling flange and the planar pressure coupling face.
15. The method of claim 14 wherein the curvature causes the mounting force to be substantially evenly distributed across an area of an interface between the planar pressure coupling face and the flange face.
16. The method of claim 13 wherein at least one of the pressure coupling face and the flange face comprises the flange face.
17. The method of claim 13 wherein at least one of the pressure coupling face and the flange face comprises the pressure coupling face.
18. The method of claim 13 wherein at least one of the pressure coupling face and the flange face comprises the flange face and the pressure coupling face.
19. The method of claim 14 wherein the at least one of the pressure coupling face and the flange face is substantially planar when loaded with the mounting force.
20. The method of claim 14 wherein the curvature is in a direction of the mounting force applied to the at least one of the pressure coupling face and the flange face.
21. The method of claim 14 wherein the mounting force is applied proximate edges of the at least one of the pressure coupling face and the flange face.
22. A pressure coupling flange configured to couple to a pressure coupling face of a pressure transmitter, the pressure transmitter for measuring a process fluid, the pressure coupling flange comprising:
 - at least one passageway formed therethrough configured to convey a process pressure through the flange and to the pressure coupling face of the pressure transmitter;
 - a flange face configured to abutt the pressure coupling face of the pressure transmitter and form a seal with the pressure transmitter around the at least one passageway; and

a curvature in the flange face which is convex relative to the pressure coupling face whereby edges of the flange face are spaced apart from the pressure coupling face when in an unloaded condition and the flange face ~~is deforms~~ to be substantially planar when a mounting force is applied against the pressure coupling face of the pressure transmitter.

23. The pressure coupling flange of claim 22 wherein curvature causes the mounting force to be substantially evenly distributed across an area of an interface between the pressure coupling face and the flange face.

24. The pressure coupling flange of claim 22 including a plurality of bolt holes arranged proximate edges of the flange configured to receive a plurality of bolts therethrough which apply the mounting force to the flange.

25. A pressure transmitter for measuring a pressure of a process fluid in an industrial process, comprising:

a pressure sensor having an output related to an applied pressure;

measurement circuitry coupled to the pressure sensor configured to provide a transmitter output related to the applied pressure;

a pressure coupling face having an opening therein arranged to transfer the applied pressure to the pressure sensor; and

a pressure coupling flange having a flange face abutting the pressure coupling face configured to convey the process fluid to the opening of the pressure coupling face; and

a seal positioned between the pressure coupling face and the flange face having a ~~feature arranged~~ surface that deforms to conform to the pressure coupling face and the flange face to alter a distribution of a loading force applied between the pressure coupling face and the flange face.

26. The pressure transmitter of claim 19 including an attachment mechanism configured to apply a mounting force between the pressure coupling flange and the planar pressure coupling face.
27. The pressure transmitter of claim 25 wherein the mounting force is applied proximate edges of the at least one of the pressure coupling face and the flange face.
28. The pressure transmitter of claim 27 wherein the attachment mechanism is arranged proximate each of four corners of the flange face and the pressure coupling face.
29. The apparatus of the claim 25 wherein the feature comprises a bevel.
30. The apparatus of the claim 25 wherein the feature comprises a variable area.
31. The apparatus of claim 25 including first and second openings extending through the flange to the pressure coupling face and wherein the seal extends around the first and second openings.
32. The apparatus of claim 31 wherein the seal is aligned with at least one bolt hole in the flange.
33. The apparatus of claim 25 wherein the seal comprises a confined gasket.
34. A method of coupling a pressure transmitter for measuring a pressure of a process fluid to an industrial process, comprising:
 - receiving an applied pressure at a pressure sensor in the pressure transmitter;
 - coupling a pressure coupling flange having a flange face to a pressure coupling face of the pressure transmitter, wherein the flange face abuts the pressure coupling face, the pressure coupling flange configured to convey a process fluid to an opening of the pressure coupling face; and
 - placing a seal between the pressure coupling flange and the pressure coupling face which has a ~~feature~~ a surface that deforms under an applied loading force for evenly distributing ~~a~~ the loading force applied between the flange face

and the pressure coupling face when ~~a~~the loading force is applied therebetween.

35. The method of claim 34 including applying a mounting force between the pressure coupling flange and the planar pressure coupling face.
36. The method of the claim 34 wherein the feature comprises a bevel.
37. The method of the claim 34 wherein the feature comprises a variable area.
38. The method of claim 34 including providing first and second openings extending through the flange to the pressure coupling face and wherein the seal extends around both the first and second openings.
39. The method of claim 39 wherein the seal is aligned with at least one bolt hole in the flange.
40. The method of claim 25 wherein the seal comprises a confined gasket seal.

STATEMENT UNDER ARTICLE 19

Entry of this Statement prior to publication is respectfully requested.

The invention is used to improve the connection between a pressure transmitter and a pressure coupling flange. One of the two surfaces (either the pressure transmitter or the coupling flange) that abut one another is curved outwardly toward the other surface. However, when mounting force is applied to the two components, the curved surface deforms to substantially conform to the shape of the other surface. This acts as a caul that distributes the mounting force substantially uniformly across the two surfaces. This improves the connection between the two and reduces the likelihood of process leakage. None of the references D1-D6 teach this. That is, none of the references teach that either the surface of the flange or the surface of the transmitter housing are curved outwardly toward the other surface, but under mounting force, deform to substantially conform to the shape of the other surface. Therefore, none of the references use this geometry to improve the connection between the two surfaces by distributing the mounting force substantially uniformly across the two surfaces.