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HIGH PRESSURE DIAPHRAGM UNIT FOR FLUID PRESSURE GAUGES

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Fig. 1

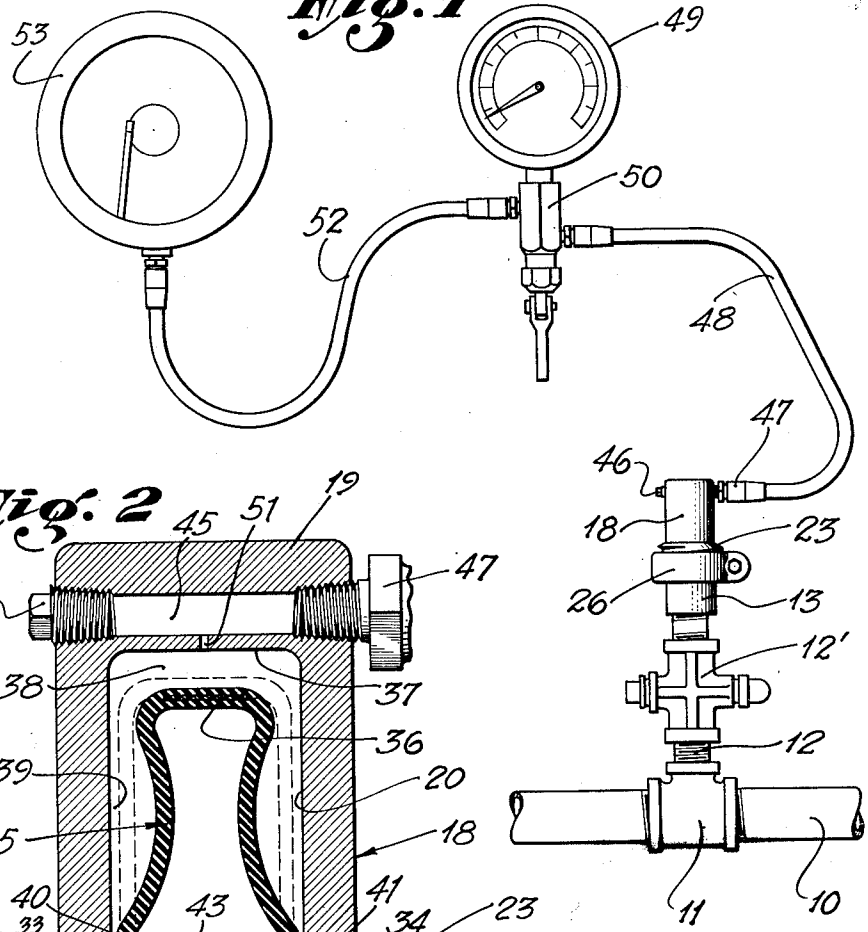
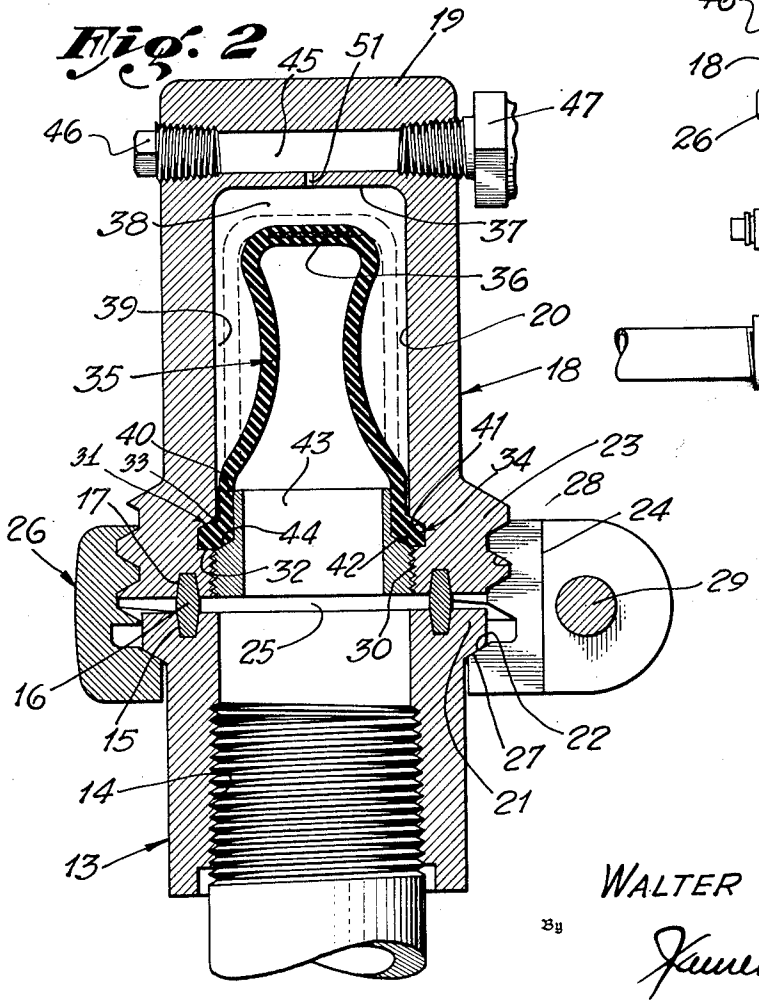


Fig. 2



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HIGH PRESSURE DIAPHRAGM UNIT FOR FLUID PRESSURE GAUGES

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4 Claims. (Cl. 137—156)

This invention relates to measuring devices and particularly pertains to a high pressure diaphragm unit for fluid pressure gauges.

In various industries it is desirable to measure the pressure of a flowing fluid continuously. In connection with the measurement of some fluids, such for example as the drilling mud fluid used in drilling oil wells, this presents a problem which is difficult to solve, due to the fact that the drilling fluids have high specific gravity and viscosity and are flowing under high pressure, while in addition they carry a large proportion of suspended solids which may easily deposit on the parts of the apparatus and render the structure inaccurate and at times inoperative. Devices of this general type are shown in my issued Patent No. 2,216,374, dated October 1, 1940, and entitled "Fluid gauge." At present the trend in well drilling operations is toward the drilling of deeper wells. These wells are as much as 15,000 feet in depth, and it is necessary to circulate drilling fluid down through the drill string to the bottom of the well, and then to elevate the fluid within the well bore and around the drill string to the surface. It is obvious that such an operation requires the use of mud pumps, which impose an enormous pressure upon the pumping equipment and the conduits, and which pressure it is desirable to ascertain constantly and to regulate. It is the principal object of the present invention, therefore, to provide a fluid pressure diaphragm to be used in connection with the circulation of drilling mud and the operation of pressure gauges, and by which the pressure gauge will be protected directly from the clogging and objectionable action of the fluid, and will at all times be sufficiently sensitive to insure that a pressure impulse will be imparted from the stream of fluid to the gauge without danger of rupturing the parts of the gauge or clogging the conduits.

The present invention contemplates the provision of a high pressure diaphragm unit which may be interposed between a high pressure fluid line and a gauge, whereby the fluid in the line will be separated at all times from the fluid in the gauge, said diaphragm unit comprising an outer cylindrical shell of great strength within which a tubular deformable cup is provided acting as a diaphragm and responding to the pressure of fluid in the flow lines while imparting pressure to a separate fluid indicating or recording gauge.

The invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view in elevation showing the application of the present invention to a mud weight indicating structure.

Fig. 2 is an enlarged view in central vertical section showing the high pressure diaphragm unit with which the present invention is particularly concerned.

Referring more particularly to the drawing, 10 indicates a mud conduit through which fluid mud is passed from suitable mud pumps to the swivel head of a string of drill pipe. Interposed at a point in the length of the conduit 10 is a T-fitting 11 having an upwardly extending threaded section 12 leading therefrom. Mounted upon the threaded section 12 is a union element 13. A stop cock 12' is interposed between the threaded section 12 and the union 13. This element has an internally threaded bore 14 to receive the threaded member 12 leading from the T-fitting 11. The upper edge of the union element 13 is formed with an annular groove 15 which has opposite side walls tapering toward each other and within which a sealing ring 16 is seated. The sealing ring is of a width more than twice the depth of the groove 15 and its opposite edges are tapered and made complementary so that the upwardly projecting portion of the sealing ring will seat within an annular groove 17 formed in the dome 18 of the structure. The dome 18 is cylindrical and extends upwardly with its center in longitudinal alignment with the center of the member 13. A head 19 is formed at the upper end of the dome and below the head a chamber 20 occurs. This chamber is cylindrical and is open at its lower end. Formed around the outside of the union member 13 and adjacent to its upper end is a shoulder 21 having a tapered face 22. Formed around the lower end of the wall of the dome 18 is an enlarged shoulder 23 having screw threads 24 cut into it. The width of the packing ring 16 is such as to cause a space to occur between the contiguous end faces of the member 13 and the dome 18, as indicated at 25. Mounted around the contiguous ends of the members 13 and 18 and over the shoulder 21 and the shoulder 23 is a draw collar 26. This collar has a lower annular tapered shoulder 27 which overhangs the shoulder 21 on the member 13 and bears against the shoulder face 22. The collar is also formed with complementary threads 28 which engage the threads 24 of the shoulder 23. By this arrangement the draw collar 26 may be rotated, and while moving along the face 22 of the shoulder 21 will act through the threads 24

and 28 to pull the dome member 18 and the union fitting 13 toward each other while compressing the sealing ring 17 into the grooves. The draw collar is split and is provided with a bolt 29 by which it can be tightened after it has been set.

The lower end of the chamber 20 within the dome 18 is threaded at 30 for a predetermined distance, the threaded section terminating in a groove 31 having a lower square face 32 and an upper tapered face 33. The groove is of sufficiently greater diameter than the inside diameter of the bore 20 and provides a clamping seat for the annular flange 34 of a pressure cup 35. The pressure cup 35 is made of deformable material, it being found that synthetic rubber is highly desirable for this purpose. The cup has an elongated cylindrical body terminating in a relatively flat upper end which is reinforced by a fabric disc 36 imbedded within the end wall. The upper end of the cup is spaced normally a distance from an end face 37 of the end wall 19 of the dome. This space is indicated at 38. The diameter of the cup is less than the diameter of the bore 20 of the dome and provides an annular side space 39. The lower end of the cup is formed with a wall portion 40 which is slightly greater in diameter than the major length of the cup and tends to reinforce the same.

The annular flange 34 of the cup is formed with an upper tapered face 41, a lower tapered face 42, and a laterally extending portion fitting over the face 32 of the groove 31. A retaining ring 43 is screwed into the threaded bore 30 and has a reduced upper portion extending into the portion 40 of the pressure cup 35. A shoulder 44 occurs at the juncture between the threaded portion of the retaining ring and the reduced extension. This shoulder conforms to the tapered face 42 of the cup and tends to force the flange 34 of the cup into a gripped position. A central unobstructed passageway is formed through the ring and permits the fluid within the member 13 to flow freely upwardly and to exert a pressure on the entire area of the inner surface of the pressure cup 35.

Disposed transversely of the end wall 19 of the dome is a passageway 45. A check valve 46 is threaded into one end of the passageway and a hose coupling 47 is threaded into the opposite end of the passageway. This coupling carries a high pressure hose 48. The hose 48 leads to a pressure gauge 49. It may be desirable to provide a pressure dampener 50 between the gauge 49 and the hose 48, such a dampener being shown in my issued patent entitled "Pressure dampener," No. 2,091,764, issued August 31, 1937. A relatively small opening 51 establishes communication between the passageway 45 and the space 38 within the dome 18. A desirable incompressible fluid fills the hose 48, the passageway 45 and the spaces 38 and 39 within the bore 20 of the dome 18. Thus, as fluid pressure is established within the pressure cup 35 the cup will be distended and will displace the incompressible fluid within the bore 20 of the dome and force it through the fluid outlet 51. The pressure dampener 50 may also be connected with a tube 52 leading to a recording pressure gauge 53.

In operation of the present invention the high pressure diaphragm unit is made and assembled as indicated in Fig. 2 of the drawing. In practice it has been found desirable to make the dome 18 of high strength steel and the pressure cup 35 of high strength synthetic rubber, for the reason that when used in connection with many well drilling projects the pressure of the mud fluid reaches a pressure of the order of 10,000 pounds per square inch. It will be evident, therefore, that the strength of the metal parts must be adequate, and that the synthetic rubber cup must be sufficiently reinforced so that under extreme pressures it will be confined by the walls of the dome and will be restrained from bursting. As the fluid pressure is forced through the pipe 10 it will rise in the column provided by the member 14 and the dome 18 and will tend to distend the walls of the pressure cup 35. Excessive pressure will force these walls outwardly against the wall of the bore 20 and may distend the cup lengthwise, until the closed end of the cup engages the end face of the bore 20. At such a time the end face will cover the opening 51 and interrupt communication between the bore 20 and the passageway 45. As the pressure cup is distended it will force the incompressible fluid from the bore 20 and through the opening 51 into the passageway 45. This fluid will then be forced through the hose 48 to the pressure dampener 50 and may then be forced into the pressure fluid responsive elements of the gauge 49 and the recorder 53. By this arrangement pressures may be handled which are greatly in excess of those which could be handled by the usual flat disc diaphragm or sylphon bellows. At the same time it will be evident that the stretching of the walls of the cup will be limited so that they will not become ruptured or fatigued, and so that the pressure of the fluid flowing in the pipe 10 may be imposed upon the incompressible fluid confined within the dome 18 and the hose 48. In the event that it is necessary to change pressure cups or to clean the device, the draw collar 26 may be released and the dome separated from the member 13.

Attention is directed to the fact that the hydraulic unit here disclosed is relatively small and compact in design and rugged in construction, so that it will withstand high pressures and rough usage and provide a suitable commercial unit to be used in well drilling operations.

While I have shown the preferred form of my invention as now known to me, it will be understood that various changes may be made in combination, construction and arrangement of parts by those skilled in the art, without departing from the spirit of my invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A high pressure diaphragm unit of the class described, comprising a lower tubular section, a cylindrical dome disposed thereabove, said dome having a cylindrical recess within it in longitudinal alignment and direct communication with the upper end of the lower tubular section, a partition wall across the upper end of the dome and forming a space thereabove having a passageway leading from the recess in the upper end of the dome through the partition and into said space, a discharge conduit connected with said space, means detachably connecting the dome to the tubular member and sealing the same, a deformable pressure cup having a closed upper end and a cylindrical side wall, the lower end of the cup having an annular flange around the mouth thereof, the dome having a seat within the recess to receive said flange, and a retaining ring threaded into the mouth of the recess to clamp the flange of the cup in sealed relation to the wall of the dome.

2. A high pressure diaphragm unit of the class

described, comprising a lower tubular section, a cylindrical dome disposed thereabove, said dome having a cylindrical recess within it in longitudinal alignment and direct communication with the upper end of the lower tubular section, a partition wall across the upper end of the dome and forming a space thereabove having a passageway leading from the recess in the upper end of the dome through the partition and into said space, a discharge conduit connected with said space, means detachably connecting the dome to the tubular member and sealing the same, a deformable pressure cup having a closed upper end and a cylindrical side wall, the lower end of the cup having an annular flange around the mouth thereof, the dome having a seat within the recess to receive said flange, and a retaining ring threaded into the mouth of the recess to clamp the flange of the cup in sealed relation to the wall of the dome, the upper end of the cup being spaced normally a distance from the upper end of the recess and having an opening therethrough, said opening being closed by the upper end of the cup when the cup has been distended by the action of fluid pressure internally thereof.

3. A high pressure diaphragm unit comprising a cylindrical dome formed with a central cylindrical cavity therein extending from the lower end of the dome and a passageway formed in the upper end of the dome communicating with said cavity through a relatively small fluid outlet opening which extends between said passageway and the upper end of the cavity within the dome, the open end of the cavity being internally threaded for a predetermined distance, an annular recessed shoulder formed in the wall of the cavity at the upper end of said threaded section, a pressure cup mounted within the recess of the dome, said pressure cup being characterized as having a cylindrical body wall of a diameter sufficiently less than the diameter of the wall of the cavity, an end wall spaced from the upper end of the cavity whereby a fluid space will be created, the lower end of said cup being formed with an outturned flange fitting in the annular seat in the wall of the dome, and a retaining ring adapted to be threaded into the threaded end of the cavity and resting against the pressure cup to hold it in its seated position.

4. The structure of claim 3 wherein said retaining ring includes an upwardly extending portion which projects into the cup for a distance beyond the annular seat.

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