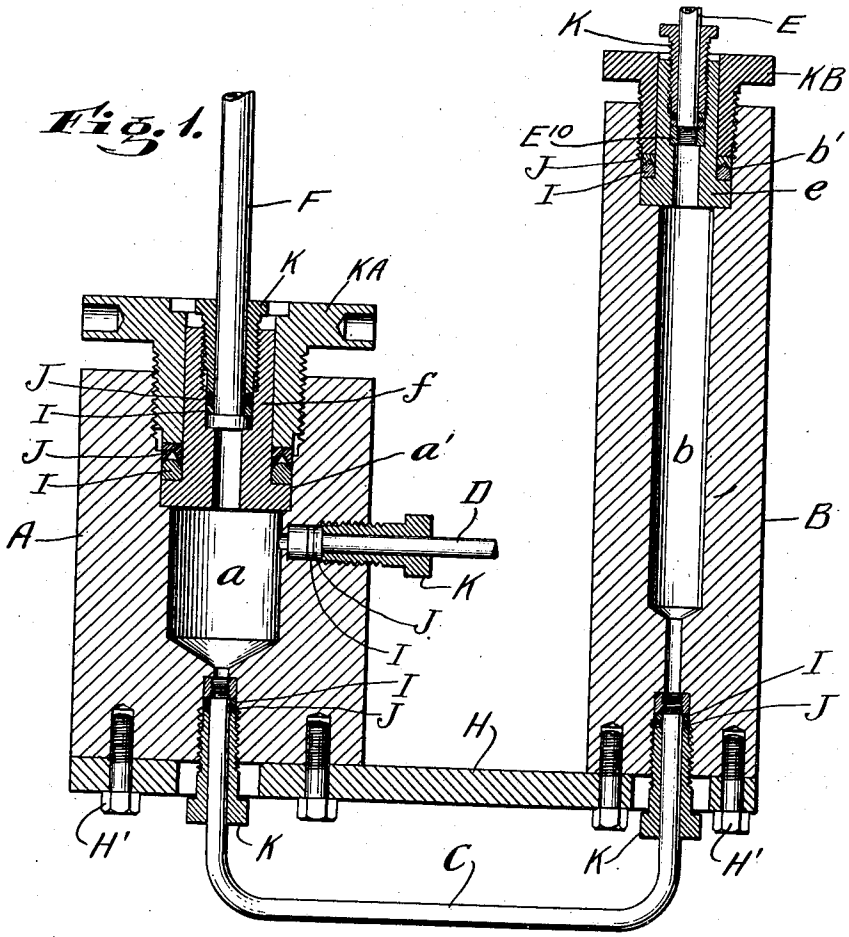
May 31, 1932. L. B. WINTON 1,860,759

MANOMETER

Filed Aug. 20, 1929

Fig. 1.



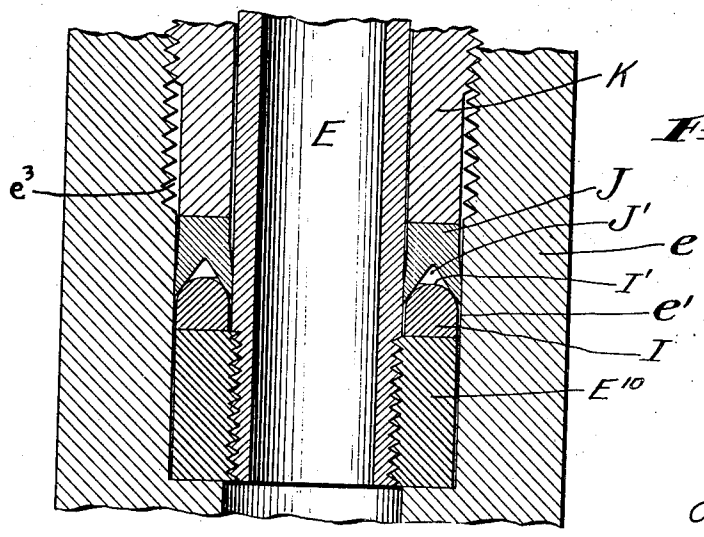


Fig. 2.

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UNITED STATES PATENT OFFICE

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MANOMETER

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The general object of the present invention is to provide a manometer, and constructive features for use therein, which may be successfully employed with internal fluid pressures much higher than are customary and which may reach, or exceed, twenty thousand pounds per square inch.

Even with the much lower pressure heretofore customary, difficulty has been experienced in providing suitable joints between the manometer proper and the pressure transmitting tubes or pipes connected thereto, and such difficulty becomes more pronounced as the internal manometer pressure increases. In accordance with the present invention, such difficulty is avoided by the employment of self sealing joints specially devised for the purpose and comprising means for utilizing the internal fluid pressure to force resilient metallic packing ring parts against cooperating joint surfaces with a contact pressure greater than the fluid pressure and increasing as the latter increases.

Advantageously I form the manometer itself of sections or parts which are connected by self sealing joints similar to those mentioned above, and each of which may be simple in shape and of a form facilitating its construction with the required strength.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

Of the drawings:—

Fig. 1 is a sectional elevation of a manometer; and

Fig. 2 is an enlargement of a portion of Fig. 1.

In the embodiment of my invention illustrated in the drawings, a manometer of the U-tube type is formed with separate high and low pressure leg members A and B, respectively, each of which is advantageously a steel body of cylindrical outline. The high pressure manometer chamber *a* is axially disposed in the member A, and the low pressure manometer chamber *b* is axially disposed in the member B. The chambers *a* and *b* are in communication through a U-shaped tube C having one end secured in the lower end of the member A, and opening into the chamber *a*, and having its other end secured in the lower end of the member B and opening into the chamber *b*. Fluid pressure is transmitted to the chamber *a* by a pipe D shown as secured in an opening formed for the purpose in the side of the member A, and opening into the chamber *a* near its upper end, and above the normal upper level of the mercury or other sealing liquid partially filling the chamber *a*. Fluid pressure is transmitted to the upper end of the chamber *b* through a pipe E co-axial with the chamber *b* and secured in a bushing *e*, the latter being secured in a cylindrical recess *b'* formed in the member B at the upper end of the chamber *b* and which, as shown, is co-axial with and may be regarded as an enlarged extension of the chamber *b*.

As shown, a tube F co-axial with, and open at its lower end to, the chamber *a*, and closed at its upper end, is secured in a bushing *f* mounted in a recess *a'* formed in the upper end of the member A, and related to the chamber *a* as the recess B' is related to the chamber *b*. The tube F which may have its upper end closed by a suitable plug (not shown), is adapted to receive a magnetic body or armature core carried by the stem of a float riding on the seal liquid of the chamber *a*, and cooperating with electro-magnetic means external to the tube F to afford a measure of the height of sealing liquid in the chamber *a*. Said core, float and external electro-magnetic means are not illustrated herein, as they form no part of the present invention and may be such as are employed in existing manometers which are well known and in extensive use. It is noted, however, that the tube F may advantageously be formed of a well known alloy comprising eighty parts of nickel and twenty parts of chromium, which is non-magnetic and of electrical high resistance, and possesses the

necessary strength to adapt it for the high pressures contemplated in the normal use of the present invention. As shown, the members A and B are attached as by bolts H' to a support or base member H.

In accordance with the present invention, similar self sealing joints are employed to connect the tubes C and D and the bushings *e* and *f* to the parts A and B, and to connect the tubes E and F to the bushing *e* and *f*, respectively. These joints are all identical in principle, and as shown, are all identical or substantially so, in form, so that it will be sufficient to describe in detail only the one of these joints shown in Fig. 2 which is an enlarged scale illustration of the joint between the pressure transmitting tube E and the bushing *e*.

For the purposes of its connection to the pipe E, the upper portion of the bore of the bushing *e* is enlarged to form a cylindrical recess *e'* large enough to receive an outwardly projecting flange portion E^{10} carried by the pipe E at its lower end. As shown, the flange E^{10} is in the form of a ring nut threaded on the pipe E. Seated on the upper end of the flange E^{10} is a packing ring I having its upper end I' rounded, and extending into a groove J' formed in the adjacent end of a second packing ring J. The opposite end of the packing ring J is engaged by an ordinary screw gland member K threaded into the enlarged and internally threaded upper end portion e^3 of the recess *e'*.

For the purposes of the present invention, the packing ring parts I and J should be accurately made, but no attempt is made to approximate a driving fit of the packing rings on the tube E, or in the recess *e*. On the contrary, I ordinarily provide clearances of two thousandths of an inch or so between the packing rings and the pipe E and the outer wall of the chamber *e'*, while the clearance between the wall of the chamber *e'* and the flange E^{10} may well be as much as four thousandths of an inch or so. For use with the high pressures contemplated, the ring I is preferably made of hardened steel and has its rounded end polished. The ring J is preferably made of unhardened low carbon steel, and while it should be accurately machined, it need not be polished. The curvature of the rounded end I' of the ring I should be such, relative to the inclinations of the side walls of the groove J' in the ring J, that the side walls of the groove will be truly tangential to the portions of the rounded surface of the ring I in engagement therewith, and that the two curved lines or narrow zones of contact will be in the same plane transverse to the axis of the tube E.

As those skilled in the art will understand, the ring I of the joint shown in Fig. 2 is normally pressed against the abutting ring J by a loading force due to the fluid pressure in the manometer, and approximately equal in amount to the action of that pressure on the area of a circle, the diameter of which is the external diameter of the flange E^{10}. This loading force wedges the side walls of the groove J' in the ring J apart, and into contact with adjacent walls of the recess *e'* and tube E. The contact pressure between the walls of the groove J' and the surfaces of the parts E and *e* with which they are in engagement depends, of course, upon the proportions of the parts, and depends in particular upon the external diameter of the flange E^{10}, and in practice I prefer to proportion the parts so that the said contact pressure per unit of area is at least one and a half times the fluid pressure per unit of area in the manometer.

With a joint constructed and proportioned as described, the fact that the contact pressure between the walls of the groove J' and the cylindrical surfaces into engagement with which they are wedged or cammed by the ring I, varies with, and substantially exceeds the fluid pressure per unit of area in the manometer under all normal operating conditions, effectually insures against joint leakage. With a properly designed joint construction of the type described, the spreading apart of the side walls of the groove J' does not stretch those walls beyond the elastic limit, at least to an extent sufficient to interfere with the ready taking down and reassembly of the joint when necessary. Furthermore, the assembly, taking down and reassembly of joints may be effected with an ordinary hand wrench even in the case of joints used with fluid pressures in excess of twenty thousand pounds per square inch.

As previously explained, the different self sealing joints are not only all alike in principle, but, as shown, are identical in form except in the following respects:—

The joint between the bushing *e* and the part B is sealed by packing rings I and J held between a screw gland member KB and a flange portion of the bushing *e* which is integral with the latter, instead of being threaded thereon, as is the flange ring E^{10} of the tube E. Similarly, the joint between the bushing *f* and the part A comprises packing rings I and J compressed between a screw gland member KA, and an integral flange portion of the bushing *f*. As those skilled in the art will readily see, the bushings *e* and *f* are advantageously employed primarily because the cavities in the members B and A in which said bushings are mounted, are materially larger in diameter than the tubes E and F. The openings in the members A and B into which the tubes D and C are inserted, may readily be made of the proper size so that no bushings, corresponding to the bush-

ings *e* and *f*, are required in connection with the joint connections for tubes C and D.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. A manometer adapted for use with high internal fluid pressures and comprising separate chambered members forming the manometer legs, a U-tube through which the lower ends of the chambers in said legs are in communication, pressure transmitting tubes communicating with said chambers, all of said parts being constructed to withstand internal fluid pressures of several thousand pounds per square inch, and self sealing joint connections by which each of said members is detachably connected to each of the said tubes in communication therewith and each comprising a pair of cooperating packing rings, one of which is expansible into sealing contact with each pair of connected parts by said other packing ring.

2. A container for fluid under high pressure comprising a part formed with a fluid containing space and with a cylindrical recess open at its inner end to said space, a tubular part having one end entering said recess and formed with an external flange at its entering end, a gland member surrounding said tubular part and detachably secured in the outer end of said recess, and two packing rings surrounding said tubular part and located end to end between said gland member and flange, the adjacent ends of said packing rings being formed, one with circumferentially extending groove, and the other with a rounded end entering said groove and actuated by said fluid pressure to spread the inner and outer walls of said groove into engagement with said tubular part and with the outer wall of said recess, respectively, with a contact pressure substantially in excess of the fluid pressure in said container.

3. A container for fluid under high pressure comprising a part formed with a fluid containing space and with a cylindrical recess open at its inner end to said space, a tubular part having one end entering said recess and formed with an external flange at its entering end, a gland member surrounding said tubular part and detachably secured in the outer end of said recess, and two packing rings surrounding said tubular part and located end to end between said gland member and flange, the adjacent ends of said packing rings being formed, one with a circumferentially extending groove having flexible side walls, and the other with a hardened rounded end entering said groove and actuated by said fluid pressure to spread the inner and outer walls of said groove into engagement with said tubular part and with the outer wall of said recess, respectively, with a contact pressure substantially in excess of the fluid pressure in said container.

4. A manometer adapted for use with a high internal fluid pressure and comprising separate chambered members forming the manometer legs each formed with a cylindrical opening in its lower end, and a U-tube having its ends received one in the said recess of one, and the other in the said recess of the second of said members and through which the lower ends of the chambers in said legs are in communication, the portion of said tube entering each recess being formed with an external flange at its entering end, a gland member surrounding each tube end and detachably secured in the outer end of the corresponding recess, and two packing rings surrounding each entering end and located end to end between the corresponding gland member and flange, the adjacent ends of said packing rings being formed, one with a circumferentially extending groove, and the other with a rounded end entering said groove and actuated by said fluid pressure to spread the inner and outer walls of said groove into engagement with said tube and the outer wall of said recess, respectively, with a contact pressure substantially in excess of the fluid pressure in said manometer.

Signed at New York, in the county of New York and State of New York, this 19th day of August, A. D. 1929.

LEWIS B. WINTON.