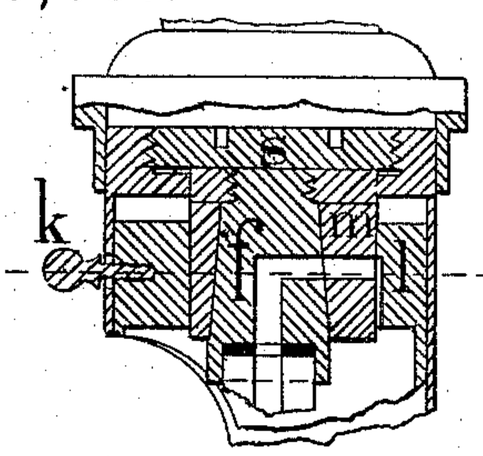
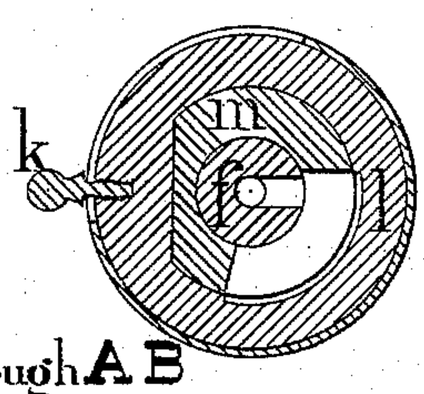
J. BROWN, Jr.

Pressure-Gages.

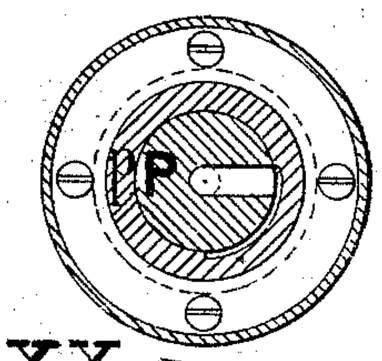
No. 156,691. Patented Nov. 10, 1874.

Fig. 1 A





Sec. through A B



Sec. through X Y

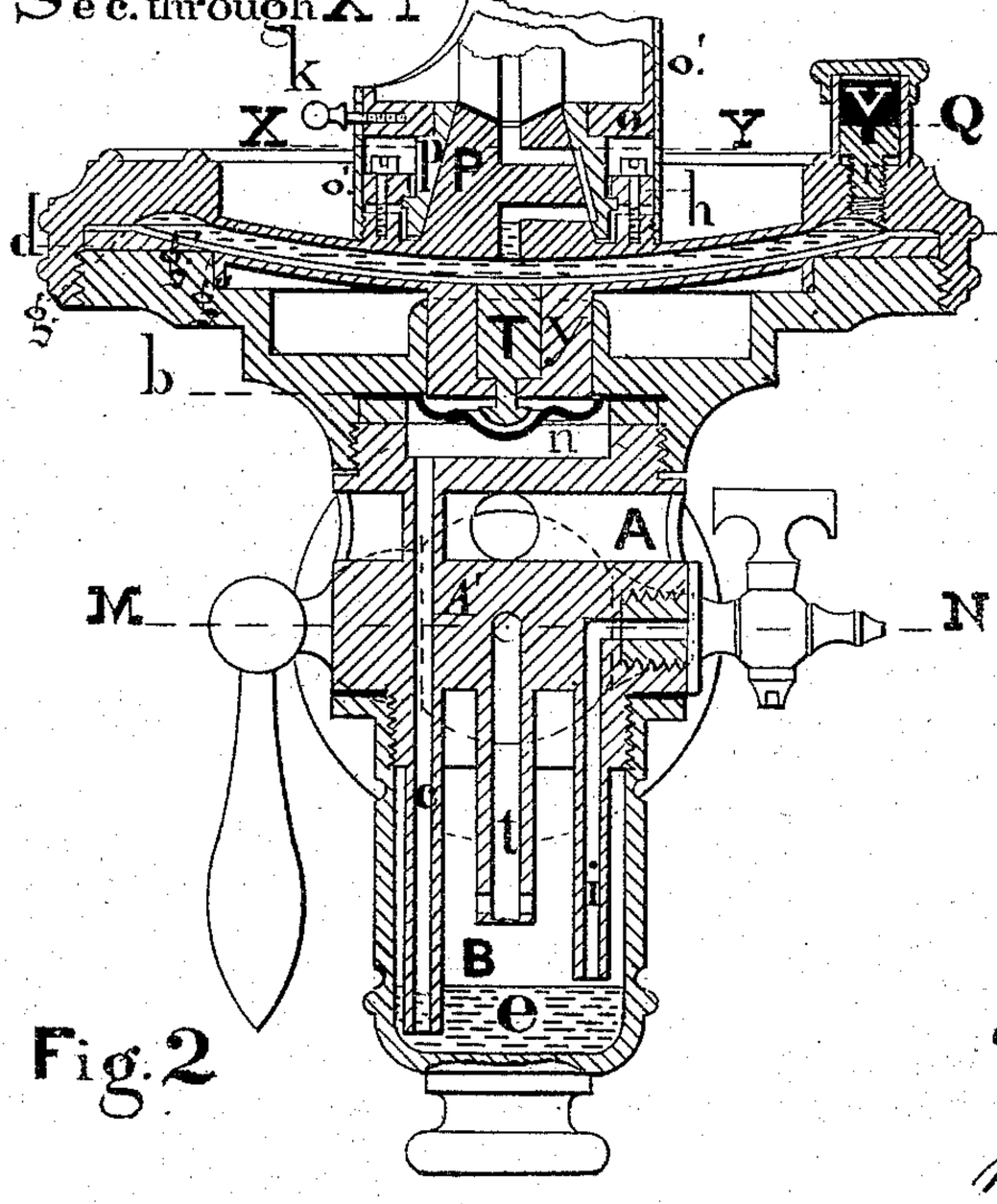


Fig. 2

Fig. 7.

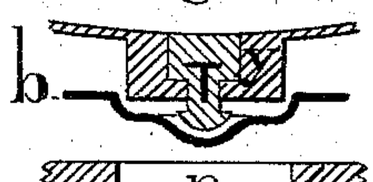
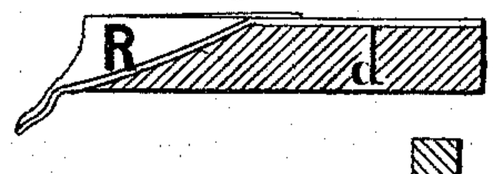


Fig. 8.



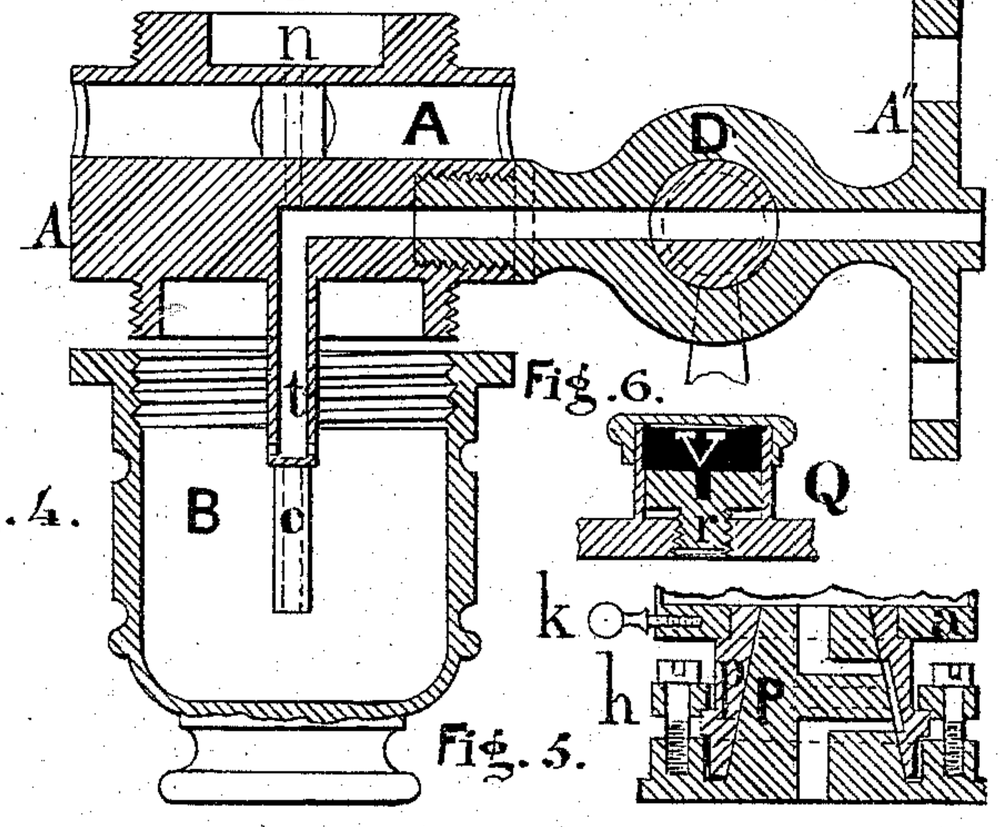


Fig. 4.

Fig. 6.

Fig. 5.

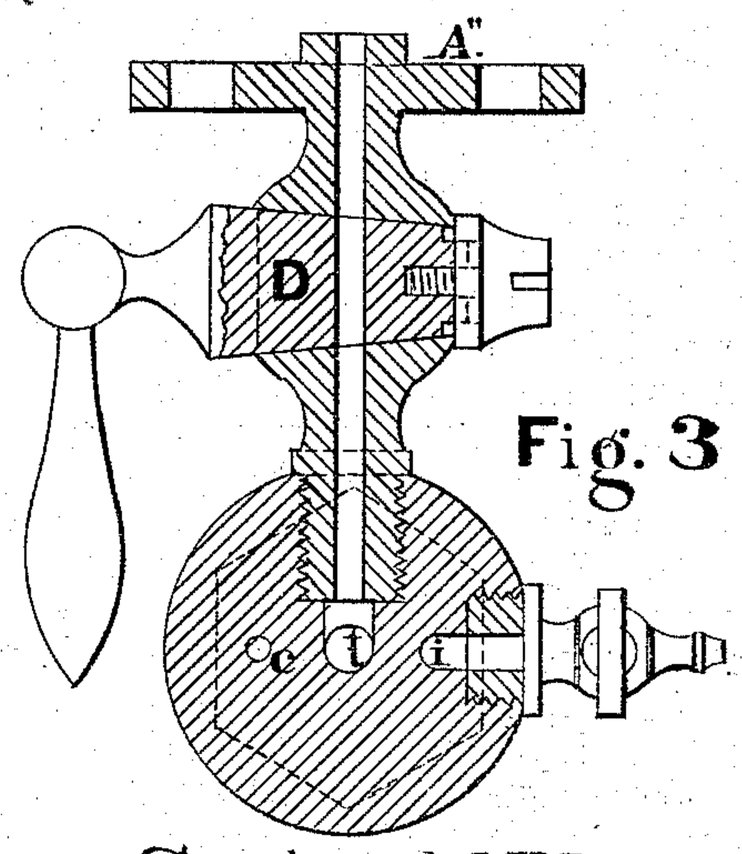


Fig. 3

Sec. through M N

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by Atty's Dodges
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UNITED STATES PATENT OFFICE.

JEFFERSON BROWN, JR., OF NEW YORK, N. Y.

IMPROVEMENT IN PRESSURE-GAGES.

Specification forming part of Letters Patent No. **156,691**, dated November 10, 1874; application filed June 29, 1874.

To all whom it may concern:

Be it known that I, JEFFERSON BROWN, Jr., of the city, county, and State of New York, have invented certain Improvements in Pressure-Gages, of which the following is a specification and description:

The improvements relate more especially to that class of mercurial gages or manometers in which the height of the column of mercury necessary to balance and indicate any given pressure is reduced by the interposition of a double-headed piston having one head smaller than the other; and the specific nature of the improvements will appear more particularly from the following specification, and the claims thereto attached, reference being had to the drawings, in which—

Figure 1 represents a vertical section of the top of the instrument, with the devices for closing the mercury-tube, and a horizontal section of the same through the line A B of the vertical section. Fig. 2 shows a vertical section of the lower part of the instrument, with a horizontal section through the line *x y* of the vertical section, showing a somewhat similar device for shutting off the mercury in the bulb from the mercury-tube; Fig. 3 being a horizontal section of Fig. 2 through the line M N. Fig. 4 is a vertical section of the lower portion of Fig. 2, in a direction at right angles to the latter. Fig. 5 is an enlarged view of the lower device for closing the mercury-tube. Fig. 6 is an enlarged view of the displacement-plug and sealing device; Fig. 7, a detached view of the piston, and Fig. 8 an enlarged view of the sealing-ring.

In Figs. 2, 3, and 4 a bracket, A″, is shown, having screw-holes, by which it may be fastened to the wall or boiler. To this bracket is attached the piece A′, either forming one piece with it or screwed on, the whole being perforated by the passage *t*, through which the steam is introduced into the chamber B, when the cock D is not closed, by means of its handle M. This chamber B is formed by a cap, which screws onto the piece A′, and can be readily removed therefrom for the purpose of cleaning, renewing the mercury, &c. From the piece A′ two other pipes descend into this chamber, one, *i*, being furnished with a pet-cock, which serves as a blow-off cock for testing, &c., and the other, *c*, leading into the chamber *n* below the pressure-diaphragm *b*. The lower chamber, B, contains mercury, *e*, by means of which the steam-pressure is communicated through the tube *c* and chamber *n* to the diaphragm *b* and piston *y*, the mercury either acting directly on the diaphragm and piston, or indirectly, through air in the chamber *n* and pipe *c*.

By this arrangement of these devices much convenience in cleaning the instrument and in attaching it is secured. The steam-pipe and pet-cock being in the piece A′, and the cap forming the chamber B being entirely unconnected, the latter is readily unscrewed, and the instrument cleaned; and the piece A′ having the bracket attached, with the steam-pipe and cock running through, forms a ready and convenient method of attaching the instrument.

The piece A′ is the principal element in one of the most important features of my improvements. Hitherto these instruments have not been much used, owing to the fact that these diaphragms, which are usually constructed of rubber, soon become useless through the action of the heat. For the purpose of avoiding this, I have introduced this piece between the steam-chamber and the diaphragm, instead of having the steam act upon the latter directly, or through the intervention of a column of mercury.

In the piece A′ is a perforated chamber, A, surrounding the pipe *c*, and either filled with a non-conducting substance, or open so as to permit a circulation of air, which will carry off any portion of heat which might otherwise be communicated through the pipe *c*, thus completely protecting the diaphragm *p* from heat. This piece A′ might be formed solid and of a considerable length, thus effecting the same purpose; but this form would render the instrument heavy and awkward. This arrangement is superior, also, to the common siphon form of this instrument for marine purposes, as the latter is subject to great oscillations from the rolling of the vessel, the change in the level of the mercury in the legs having an exaggerated effect on the indications where the scale is reduced by the use of a piston.

Another feature of my invention relates to the diaphragm *b*, which is usually made of rubber. The purpose of this diaphragm being simply to seal the chamber *n*, and prevent the passage of the steam or mercury between the piston and the sides of the passage in which it works, the pressure acts upon the piston in proportion to the area of its smaller head.

In practice it is found that the rubber adheres to the metallic head and sides of the piston, thereby increasing the friction and vitiating the indications of the instrument.

To avoid this I have arched the diaphragm, giving it such a degree of stiffness that when the pressure is removed its natural elasticity will separate it from the piston, thus preventing adhesion. When the steam is again let on the arch will be flattened out, the diaphragm will fit closely to the piston, and the pressure will act as it should according to the area of the head of the latter.

By the word arched, I mean simply to imply that the diaphragm is slightly raised from the surface of the piston, with a slight degree of rigidity, as above described. In all cases the shape of this arch may conform to the shape of the surface of the piston-head. Where the latter is, as is ordinarily the case, perfectly plane, a simple flat arch would be a proper shape, but where the surface of the piston-head is irregular, as shown in the drawing, the shape of the diaphragm will assume that of a series of corrugations, but the whole will still form a slight arch or convexity away from the piston.

In the form of the instrument which I have shown in the drawing, the diaphragm is held in place by a ring between the piece A′ and the lower part of the bulb in which the piston works; but in practice these portions of the instruments may be joined in any of the ordinary methods familiar to the makers and users of similar instruments.

In the ordinary instruments having the double-headed pistons there are no indications of the lower pressures, for the reason that the pressure has to overcome the weight of the piston and of a column of mercury equal to the height between the piston and the lowest visible position of the glass tube. This, in most instruments, is half an inch, and the instruments fail to indicate the first eight or ten pounds of pressure.

To obviate this objection, I use a compound piston—that is to say, in the center of the large piston *y* I place a smaller one, T, in which the two heads are more nearly equal in size than is the case with the large piston. In point of fact, the head which is acted upon by the pressure of the steam, and which in the form of the instrument is the lower head, may be either a little smaller, the same size, or even a little larger than, the upper head, which acts on the indicating column of mercury.

The effect of this is that, whereas the height of a column of mercury, which is supported by a given pressure, is much reduced by the use of the large-headed piston, this effect is wholly or partially nullified by the use of the smaller one, or is even reversed.

The small piston, in the form shown, is provided with a "neck," giving it a double seat in the larger one. And this double seat is necessary, though, of course, the piston may be shaped and constructed in different ways to gain it.

When there is no pressure the small piston rests on the larger one, in the manner shown in the drawing.

If, now, a small pressure is let on, it acts on the small piston with a force proportioned to the size of its lower head, and raises it long before the larger one can move, both on account of the greater weight of the latter, and on account of the greater force with which the mercurial column acts upon its large head, and, for the latter reason, also, the small piston raises or supports the short column of mercury necessary to reach the first portions of the index with a less pressure than is necessary to move the large one.

When the pressure is sufficiently great to move the large piston the smaller one will have moved so far that its enlarged lower head will seat itself on the lower surface of the larger one, and the two will then move as one piston until the pressure is again reduced. The diaphragms, both above and below, are, of course, constructed with sufficient flexibility to fit closely the heads of the pistons when under pressure, so that the pressures will be proportioned to the areas of the heads of the pistons, and not to the areas of the diaphragms. The upper diaphragm R serves the same function that the lower one does, and in this I have overcome the tendency to adhere to the metal by the use of leather.

A leather diaphragm is shown and described in a former patent, which was granted to me on the 16th day of January, 1872, No. 122,700, and I, therefore, do not desire to claim the same here; but I have found that, in practice, the mercury under high pressures is forced through the leather. To obviate this I now use a compound diaphragm having the side next the pistons of leather and the side next the mercury of rubber, the two being cemented together, though this not necessary. A triple one might be used having the leather on both sides of the rubber, but this is not necessary, as the mercury does not adhere to the rubber, and would do no harm if it did.

It has been before proposed to form a piston-head of open metallic work, covered with a stiff, flat ring of leather to form a steam-surface and to employ, in connection with this, the common rubber seating diaphragm; but it will be seen that the leather in such case can form no part of the diaphragm, as it is necessarily too stiff for such a purpose in order that it may prevent the rubber from being involved in the meshes of an open piston. For the proper action of this diaphragm it is necessary that the point *g*, where it is secured,

should be at some distance laterally from the path of the piston. If it were secured at the point g'' it would necessarily wrinkle and fold between piston and the sides of the chamber in which it moves, and if secured at the point g' the diaphragm must be too short to follow the downward movement of the piston without stretching, or if made sufficiently large would still be liable to be caught between the piston and the sides of the chamber.

In my former patent, above referred to, such a lateral space is left, the bulb of the instrument being rounded or segmental in form, but the back of the diaphragm is entirely unsupported at the lateral space between the points g and g'', and the diaphragm is, therefore, stretched by the pressure of the mercury and the indications of the instrument vitiated. I have overcome this difficulty in this instrument by forming a diagonal or concave seat for the diaphragm between the points g and g''. As actually constructed, this seat is formed upon the sealing-ring d, which performs the functions of a washer for the diaphragm, saving it from friction while the upper and lower sides of the chamber are being screwed together, but it might be formed upon the upper surface of the lower part of the instrument, the ring or seat forming a portion of this lower part, the gist of this feature of the invention lying in the use of the diagonal seat, and not in the ring. Of course, the seat, instead of being diagonal, might be slightly concave or convexed without departing from the principle of the invention.

Also, the segmental shape given to the top of the chamber and the piston may be used in combination with this feature or dispensed with altogether. The instrument is filled through the opening stopped by the screw-plug r, and to prevent tampering with the instrument by withdrawing a portion of the mercury the space V is left above the screw-head, to be sealed up. P is a part of the upper wall of the chamber or bulb forming the stationary portion of a cock or valve, the movable portion being marked by the letter p, and provided with a flange, so that it can be screwed into position (but so that it can revolve freely) by the ring h. When in the position shown in the drawing the passages are open, and the instrument is in working condition. But if the piece p be turned the passage is closed and the mercury is confined in its chamber and the instrument may be safely transported. This turning is done by the knob k projecting through a slot in the outer tube-guard o' or case of the instrument, which is shaped like the cylindrical case of any ordinary instrument of this kind, or the outer case or shell of a cylindrical thermometer. The knob k runs through this slot into the bottom of an inner case or tube-guard, o, which is shaped like the outer one, being inside of and concentric with it, and is intended to revolve freely in the latter, and when moved forward to cover the opening in the outer tube, through which the scale is read, and to thus completely cover and protect the tube from injury. The bottom o of this inner tube-guard fits upon a polygonal seat on the movable cock p, so that the two move together. When, therefore, the scale of the instrument is covered by the inner tube-guard and cannot be seen, the cock or valve will be closed, and when the scale is open the valve will be so too. It is an old device to have a cock at this point, but serious accidents have happened by its being closed, either accidentally or by design, unknown to the persons observing the scale, in which case, of course, the mercury in the tube would mislead as to the pressure in the boiler. The connection of the inner tube-guard with the cock is designed to prevent this, and forms one feature of my invention. As the cock cannot be closed without covering the scale this at once gives a warning that the instrument is not in working condition. This connection might, of course, be constructed in a different form, as, for example, the valve might consists of a screw running into the mercury-tube, so as to close it, the head of the screw being provided with cogged teeth and geared with a rack on the inner tube-guard, and any competent mechanic could suggest other mechanical variations; but the gist of the invention lies in the connection of the tube-guard with the cock or valve.

The two tube-guards, tube, and scale are not shown in the drawing, as they are constructed in the ordinary form and need no illustration.

The upper end of the instrument is shown in Fig. 1 provided with a similar valve or cock; but this may be dispensed with or it may be substituted for the lower one, the mercury being confined in the bulb by the air in the tube. f is the upper end of the tube; m, the movable portion of the cock or valve, which is secured in position, but so that it can rotate freely by the nut screwed onto the upper end of the tube. l is the upper end of the inner tube-guard, fitted to m so that the two move together, as is shown in the sectional view; and k, the knob for moving them, which knob passes through a slot in the outer tube-guard. All the parts of the instrument are clamped firmly together by the male nut s screwing into the upper end of the outer tube-guard, the whole being neatly covered by a cap.

I am aware that corrugated metallic diaphragms have been before used in spring or aneroid gages; but in these the corrugations are designed to effect the degree of elasticity of the diaphragm; whereas my corrugated diaphragm is intended for a totally different purpose, the corrugations performing a different function, the diaphragm itself being intended for sealing purposes only, and not directly influencing the indications of the instrument.

What I desire to claim, and secure by these Letters Patent, is—

1. The steam-chamber B and pressure or diaphragm chamber n, with their connecting-

pipe *c*, substantially as and for the purpose described.

2. In combination with a piston, *y*, an arched sealing diaphragm, constructed substantially as and for the purpose described.

3. The double or compound piston T *y*, constructed and arranged substantially as and for the purpose described.

4. The combination of the tube-guard with the cock or valve, when constructed and arranged substantially as described.

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Witnesses:
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