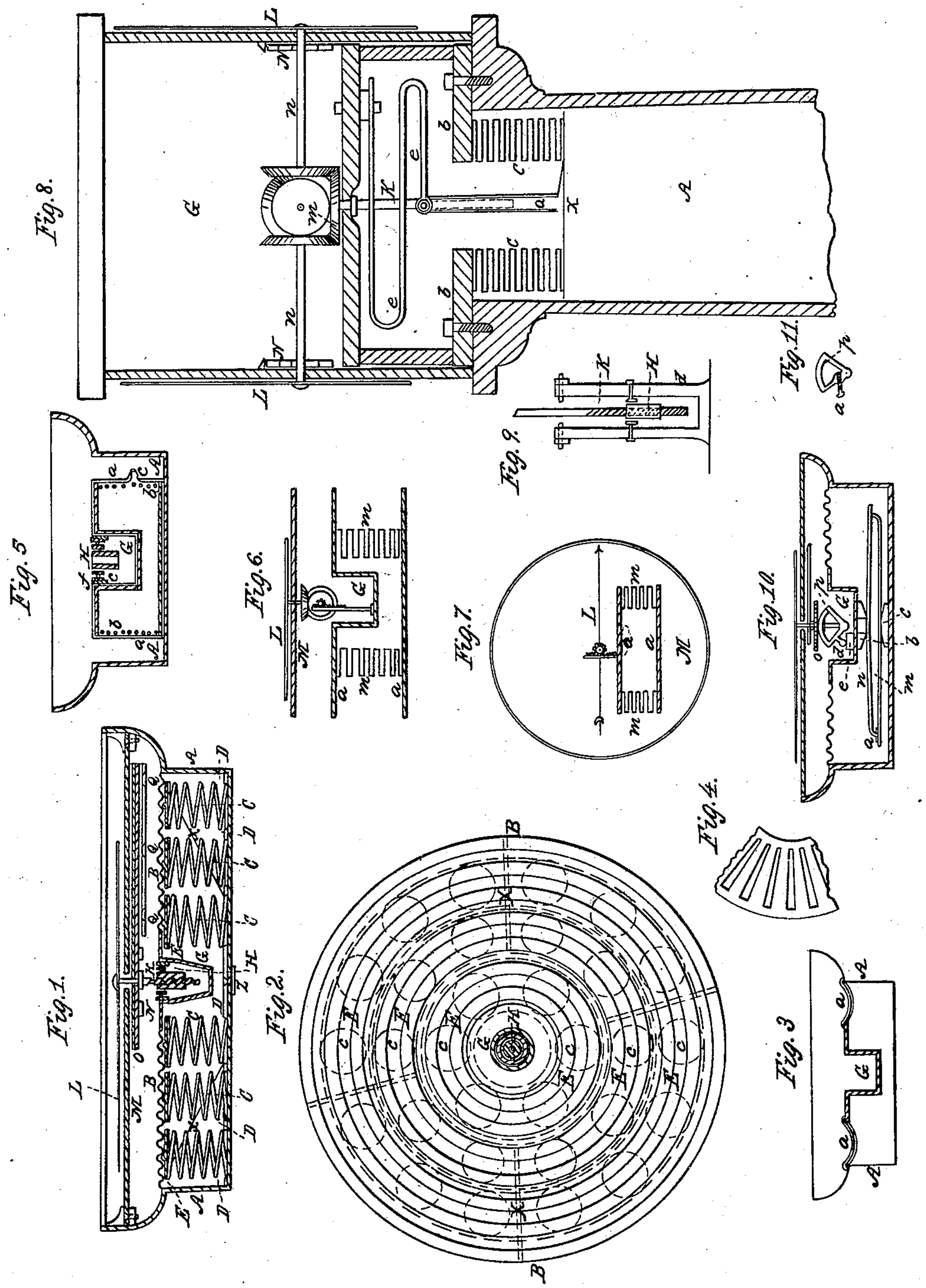
L'DE FONTAINE MOREAU.

Pressure Gage.

No. 4,702. Patented Aug. 20, 1846.



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UNITED STATES PATENT OFFICE.

PETER ARMAND, OF LONDON, ENGLAND.

BAROMETER.

Specification of Letters Patent No. 4,702, dated August 20, 1846.

To all whom it may concern:

Be it known that I, PETER ARMAND, LECOMTE DE FONTAINEMOREAU, being a subject of the King of France, but residing now at No. 1 Skinner's Place, Size Lane, in the city of London, in the United Kingdom of Great Britain, have invented a certain new and useful Mode of Constructing Barometers and other Pneumatic Instruments; and I, the said PETER ARMAND, LECOMTE DE FONTAINEMOREAU, do hereby declare the nature of the invention and the manner in which the same is to be performed and ascertained are fully described and ascertained in and by the following statement, reference being had to the drawing thereunto annexed and to the letters and figures marked thereon, that is to say—

The new mode of constructing barometers and other pneumatic instruments consists more especially in the application of thin sheets or diaphragms of metal, glass, india-rubber, or other flexible air-tight substances to certain apparatus employed for measuring the pressure and elasticity of the air and other fluids in such manner as to form a kind of elastic cushion or buffer susceptible of the slighest variation of the pressure of the atmosphere or fluid with which it is in contact and consequently indicating the amount of the same by the greater or less depression of the said yielding substances. And the invention consists generally in the application of the above principle to all those pneumatic instruments in which any reciprocating motion and oscillation takes place upon a variation in the pressure or weight of the super-incumbent column of the atmosphere, or in the pressure of the liquid in which it is immersed, or in the elasticity of a gaseous body and which instruments are commonly called barometers, manometers, &c.

I will now proceed to describe the drawing appended hereto, explaining in the course of the description the working action of the apparatus which is therein fully delineated.

Figure 1 is a diametrical section of the barometer; Fig. 2 being a horizontal view of the same with the dial plate M taken off in order to show the arrangement of the sheet B and the cup G. The instrument is constructed of brass or any other suitable material impervious to air. The lower part A A is a hollow box stoutly made, and strengthened by radial brackets X X soldered internally to insure rigidity in A A. This box is covered in an air-tight manner by a sheet or diaphragm B B of metal glass, &c., very thin that it may be the more flexible, and also corrugated circularly so as to enable it to be depressed or elevated to the greatest extent requisite without rupture. Underneath this diaphragm B B are the flat annular disks E E E made up of segments or in entire plates which serve as caps to a number of spiral springs for the purpose of supporting it against the atmospheric pressure. The lower ends of these springs six of which C, C, C, C, C, C, may be seen in the drawing, are inserted in the cavities cut for them in the false bottom, D D D D D. They communicate their pressure to the disks E E E, which diffuse it equally to all parts of the delicate diaphragm and I would here remark that I do not limit myself to what I have said above as to the number or arrangements of the springs. I can employ, for example, a single row of them under the spreading lip of the cup G, even a single one or even some concentric springs. I do not confine myself also to the spiral forms, since I can use steel plates folded in a zigzag manner or one simple plate in an oval form as in dynamometers; or arched steel plates their extremities being riveted one to the other or simply pressing one against the other as shown in Fig. 10 where *a* is a groove cut in a little piece riveted on to the end of one of the plates *m* in which lodges the bent end of the other plate *n*.

C is a cross-bit upon which rests the cup G. *e* is a similar cross-bit upon which rests the spring which last it is well to make as long as the box will admit of in order to weaken it the less.

In the center of the thin diaphragm B B a round hole is cut and its edges soldered to the lips of a small capsule or cylindrical cup G which projects into the interior of the hollow box A A, sufficient space being allowed between G and D to permit it to be depressed to its greatest required deflection. In the bottom of the box A A, and immediately under the cup G there is a small aperture Z for the purpose of exhausting the air from the box A A. This is accomplished in the following manner. A little solder is spread around the hole and a flat headed peg inserted therein sufficiently open to permit the passage of the air. The diaphragm B B with the springs, c, c, c, c, c, c, is compressed to its proper position by means of a board and a press, and is then soldered or cemented to the box A A, being retained in its place by clamps embracing the board and bottom of the instrument, which in this state is to be placed under an air pump receiver to which has been previously fitted an airtight stuffing box through which passes a smooth rod capable of moving freely therein. The inner extremity of this rod bears a soldering iron which must be heated before commencing to exhaust. This done, all is ready for the operation of the air pump, and when the vacuum is obtained, both in the instrument and in the receiver, since they are in communication by the hole Z, the hot iron must be pressed down upon the peg at z and its heat will cause the solder to melt around the peg, thereby making a complete and permanent joint. The peculiar adaptation of this barometer to its intended object, will be fore I proceed further be clearly seen. The pressure of the atmosphere being removed from the under surface of the thin diaphragm the weight of the atmosphere on the upper surface will slightly depress the diaphragm; but this weight is variable according to the state of the weather, consequently the amount of depression will be greater or less in proportion to its variation. Therefore all that is required to complete the instrument is simply to provide mechanism for accurately measuring this depression and exhibiting its amount on a dial or other ordinary scale. The contrivance which I have adopted for this purpose is very simple. In the beforementioned cup G is placed a small nut H with an internal screw thread. This nut is suspended upon a kind of universal joint which will be better understood by a reference to Fig. 2. The nut H as there seen is not directly attached to the cup G, but is balanced and plays freely on two pivots projecting from a ring which again is balanced on two other pivots at right angles to the former ones and connecting the whole with the cup G. This arrangement allows for any accidental deviation from precision which may occur in fitting together the several parts. A vertical screw K works in the nut H, or rather is worked by it, for when the cup G is depressed the nut H catches the thread of the spindle K, and causes it to turn around, when the cup G is elevated the spindle naturally turns in the reverse direction. The upper end of the spindle K, passes through the dial plate M and carries the index L which exhibits its variations upon a scale graduated in inches or any other convenient standard. And here I would again observe that I do not limit myself to the above arrangement, since I can employ for the same purpose a rack and pinion, or a chain and pulley, with two bevel wheels, see Fig. 6, in which the rack and pinion may be replaced by a chain and pulley or simply by a horizontal pinion o worked by a cogged segment p one of the bent arms of which d juts against a projecting point e of the cup G (as shown in Fig. 10). The projecting knob of the arm d is made to screw into the said arm (see Fig. 11), so as to be susceptible of being shortened or lengthened, by which contrivance the movement of the index is easily regulated to correspond with the divisions of the scale.

The influence of heat and cold in expanding and contracting metals would however disturb the regularity of its action and the faithfulness of its indications if not corrected by some means. If the increase of temperature of the thin diaphragm should cause it to rise it would indicate erroneously a light state of the atmosphere. This error is counteracted by a regulating plate O made of two strips of different metals, brass and steel for example, suppose the upper one expanding less than the other, which is fixed at Q, Q, Q, a small space being left between it and the dial M. One end of this plate projects as far as the center of the diaphragm where a small hole is bored for the spindle K to pass through. Upon this spindle a collar is fastened immediately under and abutting against the plate O, which collar in addition is provided with a coil spring N in order to keep it gently in contact with the said plate and therefore steady in the nut H. If from expansion by heat the cup G is elevated, the same temperature also acts upon the plate O which, on account of the unequal expansion of the two metals of which it is composed, would in this case curve upward to a degree proportional to the heat and equal to the height which the cup G has risen at the same moment. This would permit the spindle to rise higher instead of being turned as would be the case if it were held down while the cup rose. If the apparatus were under the effects of cold the mechanism would naturally act in the reverse manner.

The proportion of this compensation may be lessened or increased by slipping the wedge P nearer to or farther from the spindle K, the screws Q Q Q being placed so as to hold it firmly in the required position. This approaching or receding of the piece P shortens or lengthens the play of the regulating plate O and thus varies the amount of its deflections and when the proper position is once obtained it must be permanently fixed there.

To graduate the instrument I place it in a bell plunged mouth downward in a liquid in the same manner as a gasometer. This vessel is provided with a manometer and I vary the pressure by raising and lowering it, noting at the same time the arcs which the index L describes upon the dial M in consequence of the said variations. It will be seen that in the application of my principle to various useful purposes any elastic and at the same time air-tight diaphragm may be used, and also that it does not require any invariable form of apparatus for the successful operation of the said principle. In exemplification of this, I subjoin some modifications of the above arrangement. These are shown in Figs. 3, 4, 5 and 6. At Fig. 3 in lieu of the corrugated diaphragm B B, I have substituted one of copper *a*, *a*, in shape like an annular trough pierced with radial slots as will be observed in the enlarged segment exhibition at Fig. 4. This annulus is coated with a lamina of caoutchouc and the outer edge is cemented to the box A A, the inner edge being attached to the cup G which with the rest of the mechanism is similar to that of Fig. 1 and for the same purpose.

Fig. 5 represents two plates connected and entirely enveloped by a coating of caoutchouc or other supple material. The cylindrical tube of caoutchouc *a a* is kept distended by an internal spiral coil of wire C C. The lower plate is fixed to the bottom of the box A A and the upper one carries the cup G in which is seen a nut *c* with a slightly conical screw thread for the purpose of receiving a tightening screw *f* which last supports the universal joint of the nut B as above described. The air is exhausted through the india-rubber pipe *c* which is strengthened by an internal lead tube coated with wax. When the vacuum is obtained the pipe *c* must be pinched and the projecting portion cut off, and the place finally sealed with caoutchouc. Fig. 6 represents two plates *a a*, similar to the above, connected by a deeply corrugated tube of metal, glass, or other suitable material. The cup G carries a rack to work into a pinion above it, which last communicates its motion, by means of two bevel wheels fixed to the dial, to the index L. Or if the axis of the tube *m m* be placed (as shown in Fig. 7) parallel to the dial the pinion may be fixed upon the axis of the index L and the bevel wheels dispensed with. This mechanism may also be applied to the other modifications of my apparatus. If the flat projections of the tube *m*, *m* be thin and large, I give strength by stamping each of them with radial corrugations.

In all these forms if the diaphragms be not alone sufficiently strong, springs must be employed either internally or externally between the projecting portions of the upper and lower plates (as at *a a*, Fig. 6); or instead of springs the air may be left in the box A A, but in this case greater play must be given to the bimetallic regulator in order to compensate for the great expansion of atmospheric air.

The principle as above exemplified can also be applied to the construction of manometers for measuring the pressure or elastic force of gases or steam. An arrangement for this purpose is seen in Fig. 8.

A is a hollow column communicating by its base with the boiler or reservoir of the fluid to be measured. The top of this column is covered in steam-tight by the cover *b b* in the center of which is attached the corrugated tube *c c*. The bottom X of this tube according as it is more or less compressed by the steam raises the standard *d* which abuts against the spring *e e*. This standard is forked as shown in the side view Fig. 9, and between the two branches is suspended on an universal joint a nut H which in raising or falling turns the spindle of the screw K. This spindle carries at the upper extremity a bevel wheel *m*, which by communicating with four other bevel wheels transmits the indications through their axes *n n* and indices L L upon the four faces of the box G. I can also employ as a manometer the arrangement represented for the barometer, with this difference that the springs must be placed between the flexible diaphragm B B, and the dial M, the steam or gas being introduced into the interior of the box A A. It is obvious that the arrangement hereinbefore described may be applied to measuring the pressure of liquids at different depths.

And having now described the several purposes in which my principle may be rendered useful, I repeat that I do not confine myself to the exact details herein described, but that I claim as of my invention the application of flexible air-tight diaphragms of any material sufficiently elastic, and of any form which will produce the above results; that is to say, to measure the pressure of fluids, gases, &c., by the deflections of the said diaphragms.

In witness whereof I, the said Pierre Armand, Le comte de Fontainemoreau, have hereunto set my hand and seal.

L. DE FONTAINEMOREAU.

Witnesses:
P. Alexandre,
P. Richond.