No. 769,050. PATENTED AUG. 30, 1904.

W. & J. BOEKEL.

PRESSURE REGULATOR FOR FLUIDS.

APPLICATION FILED APR. 15, 1904.

NO MODEL.

Fig. 1.

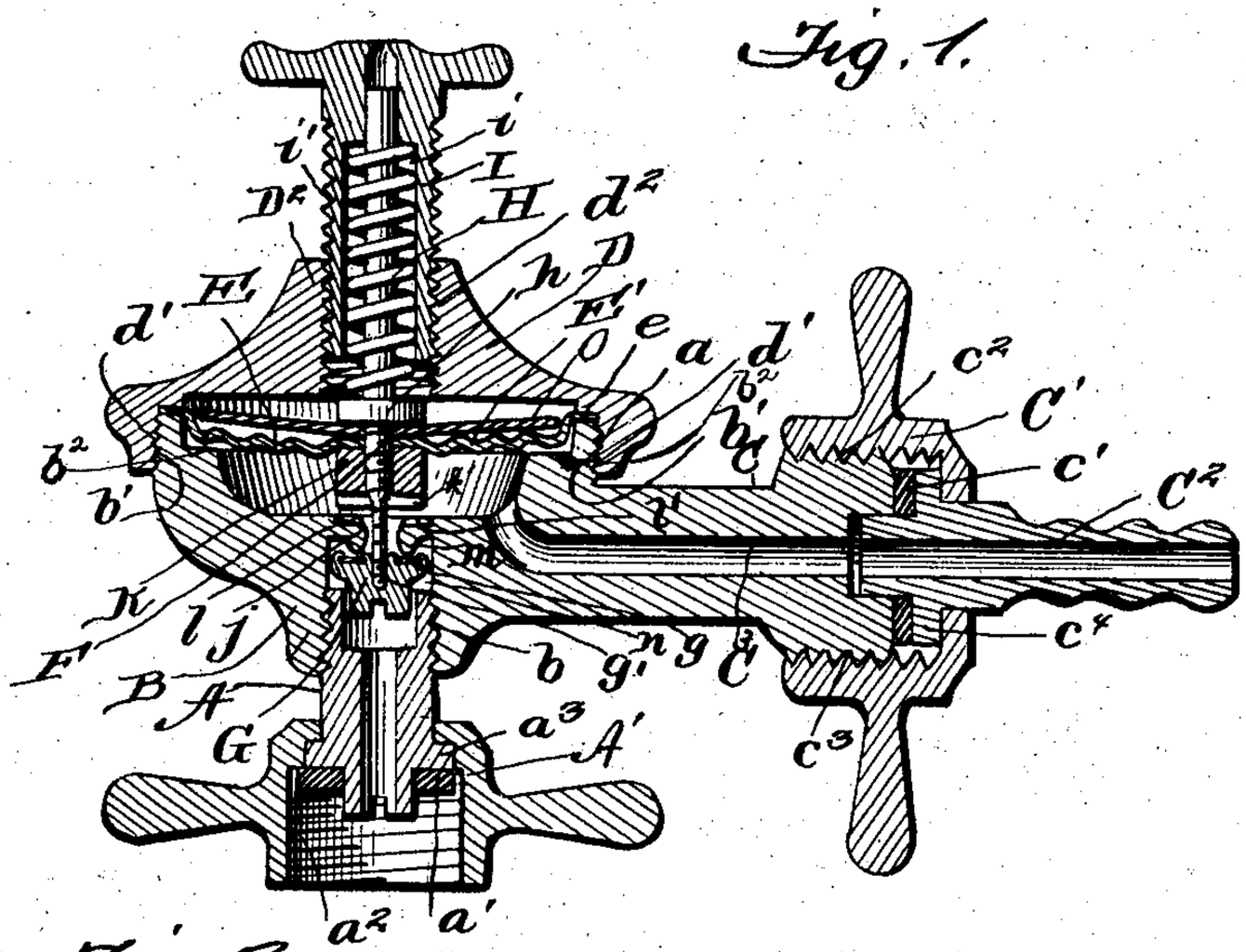



Fig. 2.


Fig. 3.

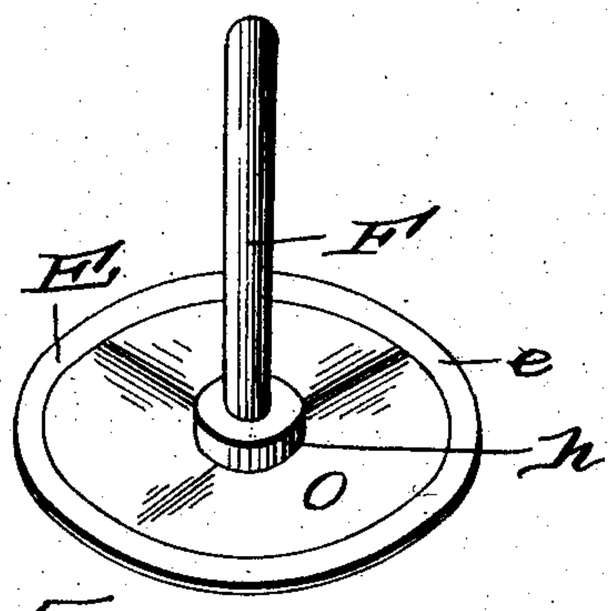



Fig. 4.

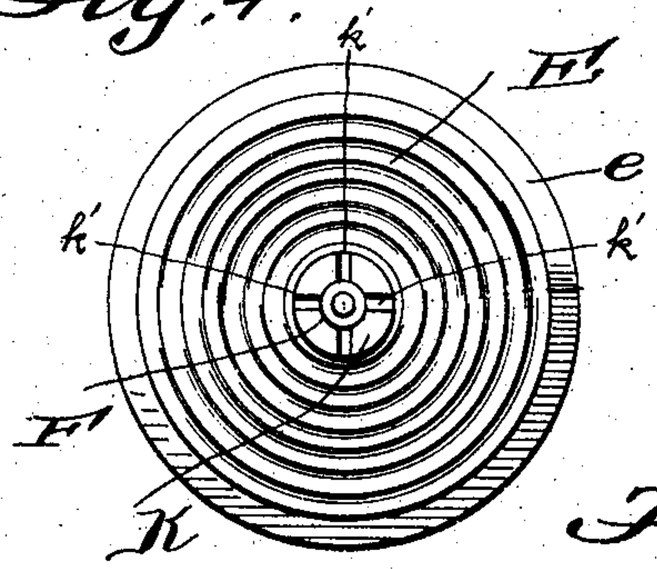
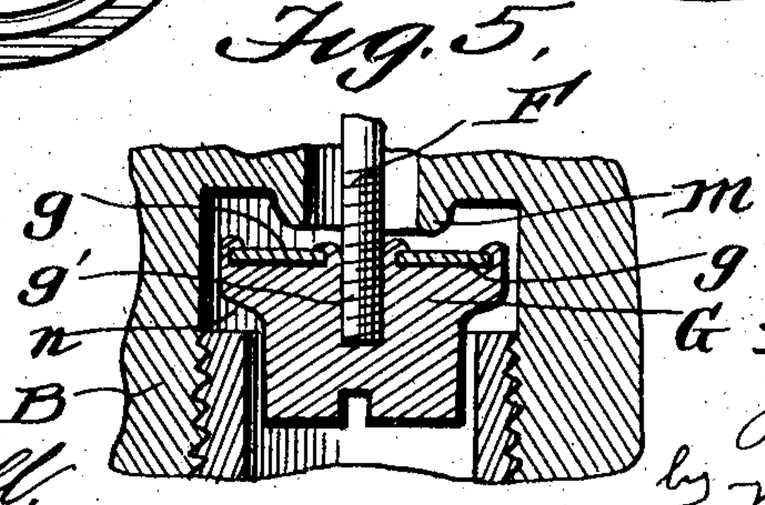



Fig. 5.




Witnesses

R. A. Boswell.

James C. Babcock

Inventors

William Boekel

Julius Boekel

by W. H. Babcock

Attorney

No. 769,050. Patented August 30, 1904.

# UNITED STATES PATENT OFFICE.

WILLIAM BOEKEL AND JULIUS BOEKEL, OF PHILADELPHIA, PENNSYLVANIA.

## PRESSURE-REGULATOR FOR FLUIDS.

SPECIFICATION forming part of Letters Patent No. 769,050, dated August 30, 1904.

Application filed April 15, 1904. Serial No. 203,288. (No model.)

*To all whom it may concern:*

Be it known that we, WILLIAM BOEKEL and JULIUS BOEKEL, citizens of the United States, residing at 518 Vine street, Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Pressure-Regulators for Fluids; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to regulators for the pressure and flow of fluid, whether liquid or gaseous; and it consists in the construction and combination of parts hereinafter more particularly set forth and claimed.

In the accompanying drawings, Figure 1 represents a vertical central section of a regulator embodying our invention on the longitudinal line of the outlet. Fig. 2 represents a detail vertical central section of the diaphragm and plate enlarged. Fig. 3 represents a perspective detail view of the diaphragm, plate, and stem. Fig. 4 represents a bottom view in detail of the diaphragm and the stem, and Fig. 5 represents an enlarged detail vertical section of the valve and proximate parts.

A designates the inlet-tube; B, the lower half of the body of the diaphragm-chamber casing, which is connected thereto by screw-threads $b$ of said parts, and C the outlet-tube, which is integral with the said part B. Couplings A′ and C′ make connection between said tubes A C and the tubular devices coöperating with the said regulator. Each of these couplings is provided with an internal packing-ring $a'$ or $c'$ and internal screw-threads $a^2$ or $c^2$. The coupling C′ has also loosely attached to it a tapering nozzle $C^2$, which is corrugated to hold the end of a rubber tube slipped over it. The internal screw-threads $c^2$ of said coupling C′, as shown, engage external screw-threads $c^3$ of the outlet-tube C, and the parts C′ $C^2$ have a certain longitudinal play with regard to each other for convenience in coupling and in separating them from each other when desired, though accidental separation while in use is prevented by a collar $c^4$ on the rear end of the said nozzle exceeding in diameter the outer opening of this coupling. The coupling A′ has a similar freedom of movement on the lower end of the inlet-tube and similarly guarded against separation by a collar $a^3$ of the latter. Its screw-threads $a^2$ are for engagement with similar threads on the pipe or other tubular part supplying fluid to and through the regulator. Of course these couplings may be varied to suit the nature of the parts to which they will be applied, the particular construction here set forth being by way of example only.

The lower half B of the casing for the diaphragm-chamber is provided with external screw-threads $b'$, engaging internal screw-threads $d'$ of the upper half or section D of the said casing, these two halves or sections thereof clamping between them the flat annular peripheral portion $e$ of the diaphragm E. The said diaphragm is preferably of thin metal, depressed in the middle to form a circular recess E′ in its top, extending quite to said peripheral portion $e$ on all sides. It is also a disk in shape, as shown, and corrugated for greater responsiveness and elasticity. The form of the casing composed of parts B D is approximately that of two bells of somewhat different length and spread placed mouth in mouth; but these matters of outline, size, and material may of course be widely varied. The said lower half B of the casing is provided with a broad shoulder $b^2$, presented upwardly toward the outer part of the diaphragm for contact therewith and serving to limit the downward movement of said diaphragm and valve, although additional and very effective means for attaining the same end are employed, as hereinafter described. The said diaphragm is fast on a stem F, on the lower end of which a check-valve G, having an upper rubber face $g$, is screw-threaded, as shown at $g'$, being arranged to act upward against a fixed seat, hereinafter described, for closing the inlet automatically whenever the pressure against the under side of the diaphragm E is sufficient to lift the latter. As this diaphragm is above the outlet-bore $C^3$ of outlet-tube C, it will be

affected by the back pressure from any receptacle into which the said outlet-tube may discharge directly or indirectly and in any case yields to the outlet-pressure above the valve when such pressure passes a certain degree.

A spring H, surrounding the stem F, bears down on a fixed collar or shoulder *h* of said stem, its upper end having an adjustable bearing against the upper end of the elongated interior recess *i* of an adjusting-screw I, externally screw-threaded at *i'* to engage similar internal threads $d^2$ of a neck $D^2$, integral with upper casing-section D. By turning this screw to tighten or loosen it, as desired, the tension of the said spring may be increased or decreased, holding the valve open against a greater or less fluid-pressure on the under side of the diaphragm. Of course the regulator may be inverted, and parts or faces of parts herein mentioned as downward may become upward; but the device is described for convenience in the position and arrangement shown.

The general operation, which is not new in intent at least, is to maintain uniform pressure of discharge at any predetermined degree by closing the valve and cutting off the inflow of liquid as soon as the outlet or discharge pressure on the diaghragm overcomes the resistance of the adjusted spring, the latter again prevailing and opening the valve as soon as the outlet-pressure is again below the said degree by reason of outflow without inflow. To perfectly or nearly perfectly attain this uniformity, these changes must be almost infinitesimal, the valve and diaphragm vibrating very slightly and the closure being perfect. This also obviates all jarring of the parts and unpleasant noises. To attain these ends, we provide the stem F with a fixed collar or stop K under the diaphragm and form a flat seat *l* therefor at the bottom of the diaphragm-chamber on lower casing-section B, surrounding the central opening *j*, through which the said stem passes. Immediately below this flat seat *l* is an annular downwardly-presented bead *m*, constituting a seat for the upwardly-presented rubber face *g* of valve G. The latter is located in a valve-chamber *n*, formed in the tubular lower part of casing-section B above the threads which engage the inlet-tube, the diameters of the said valve and the said chamber being relatively such as to permit the flow of fluid past the said valve when the latter is not against its seat, this flow being continued between stop K and seat *l* when the former is off the latter or through grooves *k* and *l'* of their proximate faces when these are in contact. Either set of these grooves *k* or *l'* may be dispensed with, only the other part K or *l* being grooved, and any convenient form and arrangement of said grooves may be adopted suitable for the purpose stated. The upward and downward play of the said valve is limited in one direction by the contact of said valve with seat *m*, also obviously by the contact of the diaphragm with shoulder $b^2$, and in the other by the contact of stop K with seat *l*. As these contacts leave but a slight interval for valve-opening or valve-closing motion, all jar of the parts and all slamming sounds are obviated. The downwardly-presented annular bead constituting seat *m* is rounded, so as to nearly form a blunt edge and presses slightly into the rubber face *g*, making a perfect fluid seal when the valve is seated. This rubber face prevents any perceptible sound. The two seats *l* and *m* constitute one double seat for both stop and valve, the same being simple and strong and cast in one piece with the lower casing-section B. The stop K, shoulder $b^2$, and valve G also prevent by their contact with the said seats the motion of the diaphragm E or stem F to any greater extent than that stated, thus further doing away with noise and also obviating the risk of injury by overstraining the diaphragm. Moreover, the said stop prevents the said diaphragm from being brought into contact with the lower section B of the casing, except where the two sections B D clamp the flat peripheral part of the said diaphragm between them. In view of the necessary thinness and fragility of these diaphragms this is an important consideration.

To still further protect the diaphragm, we set a plate or disk O as a brace and reinforce into the recess E' in the upper side of the diaphragm, where it is held between the latter and the collar or shoulder *h* or may be secured in any convenient way. It is preferably of metal and thick enough to guard against the overstrain or deforming of the diaphragm E by the opposing forces of the spring and the fluid-pressure. It entirely fills the recess E' and covers the top of the entire diaphragm, except the flat annular peripheral part held between the sections of the casing, and its periphery fits against the inner face of the annular wall $e^2$, formed in the said diaphragm, by depressing the said middle portion thereof. With these parts E O thus fitted and secured together and the valve G, stop K, and double seat *l m* relatively arranged as described, the diaphragm is secure against injury and insured the maximum of duration.

The stop K may, if preferred, be attached directly to the under side of the middle part of the diaphragm instead of attaching it to the stem. In either case the said stop is practically an attachment of the said diaphragm for limiting its vibration and strain. The construction and arrangement above described, and shown in Fig. 1, will generally be best.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a fluid-pressure regulator, a flexible diaphragm, a stop and inlet check-valve mov-

ing together, in combination with the diaphragm-chamber casing having an annular shoulder formed on it below said diaphragm for contact therewith, a double seat, consisting of an annular bead or flange presented to the said valve and a part presented in the opposite direction toward the said stop for the purposes set forth.

2. In a fluid-pressure regulator, a flexible diaphragm and inlet check-valve, in combination with the seat for said valve, which limits the movement of the said parts in one direction, a stem connecting said valve to said diaphragm, a stop carried by said stem and means for engaging said stop to limit the movement of the said valve and diaphragm in the other direction, the said stop being grooved to allow the passage of fluid through it while it is in contact with said means substantially as and for the purpose set forth.

3. In a fluid-pressure regulator, a flexible diaphragm and an inlet-valve and stop moving therewith, in combination with a relatively fixed part, for contact with the said stop, both of the opposed faces of the said stop and fixed part being grooved, for the passage of fluid when these devices are in contact substantially as and for the purpose set forth.

4. In a fluid-pressure regulator, the combination of a valve-controlling diaphragm with a stop carried thereby and a fixed seat, against which the said stop bears to limit its play, the said seat being grooved, for the passage of fluid when they are in contact substantially as and for the purpose set forth.

5. In a fluid-pressure regulator, the combination of a diaphragm and an inlet check-valve operated thereby with a stop carried by said diaphragm and a diaphragm-casing having integral therewith a double seat *l m*, arranged for contact with said stop and said valve alternately at all points of its circuit, to limit the play of said diaphragm and valve in both directions, the said stop and seat being constructed to permit the passage of fluid between them while they are in contact substantially as set forth.

6. In a fluid-pressure regulator, the combination of a flexible diaphragm with means for holding the peripheral part of the same, a reinforcing-plate covering all of the said diaphragm except the said peripheral part, substantially as and for the purpose set forth.

7. In a fluid-pressure regulator, the combination of a flexible diaphragm with a stem attached thereto, an inlet check-valve and stop on said stem, a fixed double seat arranged between the said stop and valve, for contact therewith alternately, and a reinforcing-plate on the other side of the diaphragm, coöperating with the said stop-valve and double seat to preserve the said diaphragm from injury by overstrain substantially as set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WILLIAM BOEKEL.
JULIUS BOEKEL.

Witnesses:
JOHN H. SCHERER,
GUSTAV A. MAIER.