(No Model.)

E. E. GOLD.

PRESSURE REGULATOR.

No. 508,133. Patented Nov. 7, 1893.

FIG. 2.

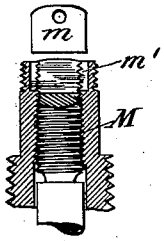

FIG. 3.

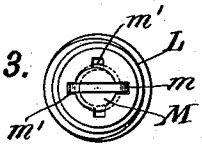

FIG. 4.

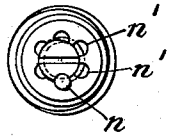

FIG. 1.

WITNESSES:

L. F. Fraser.

Fred. White.

INVENTOR:

Edward E. Gold,

By his Attorneys,

Arthur C. Fraser & Co.

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EDWARD E. GOLD, OF NEW YORK, N. Y.

PRESSURE-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 508,133, dated November 7, 1893.

Application filed February 8, 1892. Serial No. 420,799. (No model.)

To all whom it may concern:

Be it known that I, EDWARD E. GOLD, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Pressure-Regulators, of which the following is a specification.

This invention relates to reducing valves for reducing a fluid from a higher to a lower pressure, and especially to such valves as are adjustable in order that the pressure on the eduction side of the valve may be regulated at will. Pressure regulators of this character are commonly constructed with a regulating valve for choking or closing the steam passage through the casing of the regulator, and with a diaphragm exposed to the pressure on the eduction side of the valve and receiving the tension of a spring, so that while the spring tends to throw the valve open, the pressure of the steam against the diaphragm tends to close it. The fluid pressure on the eduction side of such a regulator is proportional to the tension of the spring, so that by adjusting this tension from time to time the pressure may be varied at will. For this purpose a screw spindle having an operating handle is commonly provided.

My invention provides certain practical improvements in pressure regulators of this character.

Figure 1 of the accompanying drawings is a vertical mid-section of my improved regulator. Fig. 2 is a fragmentary section of the upper part thereof. Fig. 3 is a plan of Fig. 2. Fig. 4 is a similar view to Fig. 3, but showing a modified construction.

Let A designate the valve casing, B the induction pipe, and C the eduction pipe. Within the valve casing is a partition *a* dividing it into induction and eduction chambers B′ and C′, and in this partition is formed a valve seat *b* against which closes the regulating valve D, which is mounted on a valve-stem E and receives the upward pressure of a spring *c* tending to close it. The valve casing A is formed with a diaphragm chamber F consisting of two halves or shells A′ and F′ bolted together at their margins and clamping between them the diaphragm G, which may be made of sheet metal or other suitable flexible material. The chamber F communicates with the eduction chamber C′ by means of a restricted opening *d* through a partition *e*, this opening being very slightly larger than the diameter of the stem E which passes through it, so that a slight leak is left between the stem for the passage of steam around the eduction chamber and the diaphragm chamber. On the top of the stem E is mounted a disk or head H, which is held pressed against the under side of the diaphragm by the tension of the spring *c*. On the upper side of the diaphragm is a similar disk or head I, which is formed with a tubular upward extension I′ forming within it a socket *f*, and in this socket the lower end of the regulator spring S is seated. This spring extends up within a chamber J, and its upper end presses against the enlarged head K′ of a plunger K. The upper end of the chamber J has a screw-threaded opening through which passes a screw spindle L, the threads of which screw up or down in the opening when the spindle is turned by its handle L′. Within the spindle L, which is made tubular, is an adjusting screw M whose threads engage internal threads in the spindle, and whose lower end receives the upward thrust of the plunger K. On the spindle L is screwed a cap N, which serves the double function of concealing the screw M and holding the handle L′ in place on the screw spindle. When the screw spindle L is adjusted up or down by turning the handle L′, it is clamped in position by a lock-nut P, which is provided with a handle P′ for convenience in turning it.

The induction pipe B being connected to a steam boiler or other reservoir of fluid under pressure, and the eduction pipe C being connected to a point at which it is desired to use the fluid at a lower pressure, the regulator serves to choke back the flow of fluid sufficiently to reduce its pressure to the required extent. The spring S being adjusted to the proper tension to accomplish this result, exerts a downward pressure upon the disk I, and consequently upon the diaphragm G, which pressure is communicated through the disk H and stem E to the valve D, and serves to press the valve open whenever the pressure on the eduction side of the valve falls below

that pressure to which the regulator is set. As the valve is opened and steam passes through it and increases the pressure in the eduction chamber, steam flows from the latter through the space *d* into the diaphragm chamber F, and exerts an upward pressure upon the diaphragm until this upward pressure is sufficient to overcome the tension of the spring and press the diaphragm upwardly, whereupon the spring *c* will press the valve D upward against or nearer to its seat, thereby choking back the steam and correspondingly reducing the pressure. As the pressure on the eduction side of the valve falls, the spring again presses down the diaphragm and opens the valve, so that by a balancing of the downward pressure of the spring and the upward pressure of the steam, the regulator is caused to admit steam through the valve with just sufficient rapidity to keep up the pressure beyond it to that which is required.

It will be observed that the diaphragm is a complete disk without perforations, so that there can be no leakage of steam through it into the chamber J, where the steam would rust the spring S and would be liable to escape around the spindle L. The diaphragm is also stronger than if perforated to admit the passage of the valve-stem up through it. The disk I is held in place by its tubular socket I′, which engages the lower portion of the spring S, the spring being guided by the walls of the chamber J so that it is held in central position. The diaphragm is clamped between the disks I and H, and to an extent proportional to the tension of the spring *c*. To prevent injury of the diaphragm by an excessive upward pressure of steam, the disk I is made with its tubular portion I′ projecting upward beneath the bottom of the chamber J to within a suitable distance from a shoulder *g* formed thereon, so that when the upper pressure has distorted the diaphragm to a certain extent, this tubular portion strikes this shoulder and is stopped thereby. This contact of course occurs after the valve D is fully seated, as otherwise it would interfere with the seating of the valve. When thus stopped the disk I forms a broad support for the central portion of the diaphragm and protects it from injury. When the steam pressure is reduced by the turning off of steam, the full pressure of the spring is exerted against the diaphragm, and to prevent injury of the diaphragm thereby, a downward stop is provided consisting of a boss *h* on the disk H striking the surface *i* of the partition *e*. The tension of the spring *c* is adjustable by screwing up or down a lower cap or plug *j* against which this spring is seated. This cap closes the lower side of the valve casing, and has a chamber *j′* which constitutes a guide for the lower end of the valve stem. By removing this plug the valve D and valve-stem may be withdrawn downwardly, the valve-stem being drawn out of the socket in the disk H.

In the use of the regulator the pressure on the eduction side is determined by turning the handle L′ to right or left and thereby screwing the spindle L up or down, whereby the tension of the spring S is increased or diminished. To increase the pressure, the spindle is screwed down to increase the tension of the spring S, and vice versa. The maximum pressure is limited by the under side *k* of the boss of the handle L′ striking the upper side of the nut P, thereby constituting a downward stop, while the minimum pressure is determined by the upper side of a flange *l* on the spindle L striking the upper end of the chamber J. This last provision is chiefly useful, however, to prevent the accidental withdrawing of the spindle.

For many uses it is desirable to be able to limit the maximum pressure which may exist on the eduction side of the regulator. For example, as applied to the steam heating of railway cars, such regulators are used on the engine to reduce the boiler pressure, which is usually upward of one hundred pounds per square inch, to a pressure of ordinarily from twenty to thirty pounds. In such case it is necessary at times to increase the pressure in order to more rapidly warm up the cars in cold weather, but an increase of pressure to about fifty pounds or thereabout is hazardous because of the liability of bursting the lengths of rubber hose which connect the steam pipes from car to car. It is consequently desirable to be able to so adjust the regulator that the maximum pressure cannot exceed for example fifty pounds or other predetermined limit. My invention provides a means for accomplishing this result. By screwing down the spindle L until stopped by the shoulder *k*, and then (the cap N being removed) screwing down the adjusting screw M until the spring S is brought to such a tension as will give the desired maximum fluid pressure on the eduction side of the regulator, and replacing the cap N, the regulator is so set that it can never be adjusted by the handle L′ to admit the passage of higher pressure than the maximum pressure thus determined, although by screwing up the spindle L it may be adjusted to regulate to lower pressures within any range or to any minimum for which it is constructed, (depending upon the stiffness of the spring S and the length of the spindle L.) My invention thus provides a means for adjusting the tension of the spring S relatively to the usual adjusting spindle L, or in other words, for adjusting the initial or maximum tension of the spring independent of the adjustment which is employed in the ordinary use of the regulator. This initial adjustment is effected by an adjusting-screw which is concealed from view and the presence of which is unknown to the engineer or other person who ordinarily uses the regulator. The screw-cap N appears externally to be merely the usual screw-cap for holding down the handle L, and there is no occasion for the operator

ever removing this cap. Even if he were to remove it, there would be no liability of his tampering with the internal screw.

In order to lock the internal adjusting screw to the spindle L so as to insure its turning therewith and prevent any friction between its lower end and the plunger K from holding it stationary while the spindle L is turned, in which case the initial adjustment would be impaired, I provide some means for fastening the screw M to the spindle L so that both shall be compelled to turn together. To this end I provide the screw with a deep nick or slot, which may be turned by a screwdriver, and I provide a key or flat plate of metal *m* adapted to drop into this slot, and I provide vertical notches *m'* within the upper end of the spindle L, the key *m* being wide enough so that when thrust down into the slot its sides shall enter these notches. In adjusting the screw it is brought with its slot into coincidence with two opposite notches, and the key is then slipped down so that it engages both the notches and the slot and thereby prevents the screw from turning relatively to the spindle. By then screwing down the cap N, the key *m* is prevented from being displaced, since it is held down in position by the cap. The notch in the screw head is made deep enough to allow for the necessary up or down adjustment of the screw, the key *m* in any adjustment of the screw being pressed down into the notches *m'* until it rests upon the bottoms thereof.

Fig. 4 shows a modified fastening consisting of a pin *n* entering half into a notch in one side of the screw and half into one of a series of notches *n' n'* formed within the spindle L. By screwing down the cap N this pin is kept from working out. Other means may be provided for locking the internal screw to the spindle.

The steam space *d* between the eduction and diaphragm chambers should be made of small area, this opening being simply a loose fit with the spindle. Formerly the partition *e* was omitted, the eduction chamber and diaphragm chamber being in uninterrupted communication, but this construction results in a "chattering" of the valve, due as I believe to the too sudden flow of steam into the diaphragm chamber, thereby closing the valve, and the too sudden escape of the steam from the diaphragm chamber, thereby permitting the spring to force the valve open, and by a repetition of these movements causing the valve to rapidly open and close and give rise to a distressing and destructive vibration. But by interposing the partition *e* and providing the very restricted passage *d* for the steam, the diaphragm is not influenced by sudden variations of pressure in the eduction chamber, an appreciable time being required for the steam to flow through the restricted passage, and consequently the movements thereof are gradual instead of sudden, although sufficiently prompt to afford the requisite regulation.

In case of the accidental bursting of the diaphragm there would be no damaging escape of steam, since the steam would be confined in the chamber J and could only leak out in minute quantities around the threads of the spindle L.

I claim as my invention the following-defined novel features, substantially as herein-before specified, namely:

1. A pressure regulator comprising a casing and valve-seat, a regulating valve, a diaphragm in communication with the eduction side thereof connected to the valve, a spring pressing against the diaphragm in direction tending to open the valve, a screw-spindle for adjusting at will the tension of said spring to vary the pressure determined by the regulator, an interposed adjusting screw for varying the initial tension of the spring relatively to said spindle, and a stop for limiting the screwing down of the spindle, whereby the maximum pressure of fluid to which the regulator is adjustable may be determined in setting the regulator.

2. A pressure regulator comprising a casing and valve-seat, a regulating valve, a diaphragm in communication with the eduction side thereof connected to the valve, a spring pressing against the diaphragm in direction tending to open the valve, a screw-spindle for adjusting at will the tension of the spring to vary the pressure determined by the regulator, a stop for limiting the screwing down of the spindle, and an adjusting screw within the spindle, engaging threads therein and receiving the tension of the spring and transmitting it to the spindle, whereby the initial tension of the spring relatively to the spindle may be adjusted to limit the maximum pressure of fluid that may pass the regulator.

3. A pressure regulator comprising a casing and valve-seat, a regulating valve, a diaphragm in communication with the eduction side thereof connected to the valve, a spring pressing against the diaphragm in direction tending to open the valve, a screw-spindle for adjusting at will the tension of said spring to vary the pressure determined by the regulator, and an adjusting screw inclosed within the spindle, engaging threads therein and receiving the tension of the spring and a cap for concealing said adjusting screw.

4. A pressure regulator comprising a casing A and valve-seat, a regulating valve D, a diaphragm G in communication with the eduction side thereof connected to the valve, a spring S pressing against the diaphragm in direction tending to open the valve, a screw-spindle L having a handle by which to turn it and constructed for adjusting at will the tension of the spring to vary the pressure determined by the regulator, an interposed adjusting screw M engaging threads within the spindle, and receiving the tension of the spring and transmitting said tension to the spindle, whereby the connection between the spring and spindle may be adjusted to vary

the initial tension of the spring, and a fastener for fixing said adjusting screw to the spindle, whereby to maintain the adjustment of said initial tension.

5. A pressure regulator comprising a casing and valve-seat, a regulating valve D, its stem E, the diaphragm G, the spring S pressing against the diaphragm and tending to open the valve, a plunger K receiving the opposite reaction of the spring, an adjusting screw spindle L, and an adjusting screw M screwing in said spindle and receiving the thrust of said plunger, whereby the thrust of the spring is transmitted to the spindle L through the plunger K and screw M.

6. A pressure regulator comprising a casing and valve-seat, a regulating valve, a diaphragm in communication with the eduction side thereof, a spring S, a plunger K, an adjusting spindle L having slots within it, an adjusting screw M screwing within said spindle and receiving the thrust of said plunger, a fastener *m* entering said slots for locking said screw to said spindle, and a cap N for concealing the screw and retaining the fastener in place.

7. In a pressure regulator having an imperforate diaphragm, the combination of valve-casing A A′ and spring chamber J, the latter formed with a stop shoulder *g* imperforate diaphragm G, a regulating valve with its stem bearing against one side of said diaphragm, a regulating spring S inclosed in and guided by said spring chamber, and disk I resting loosely against the opposite side of the diaphragm and having a tubular portion I′ arranged to abut against said shoulder *g* after the seating of the valve to limit the further distortion of the diaphragm, and formed with a chamber *f* receiving and fitting the lower portion of said spring, whereby the spring holds the disk I centrally in place against the diaphragm and its portion I′ in position to engage said shoulder.

8. In a pressure regulator, the combination with the valve casing, the imperforate diaphragm G, and the valve D having its stem bearing against one side thereof, of a disk I resting loosely against the other side thereof, the helical spring S pressing against the diaphragm through said disk, and a cylindrical spring-chamber for said spring formed partially in the casing at J and partially in said disk at *f*, so that the spring by being inclosed within and engaging the walls of said chambers serves to hold the loose disk in place centrally against the diaphragm.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

EDWARD E. GOLD.

Witnesses:
GEORGE H. FRASER,
FRED WHITE.