W. S. Gale,

Boiler-Furnace Draft-Regulator.

No. 20,845. Patented July 6, 1858.

Fig. 1.

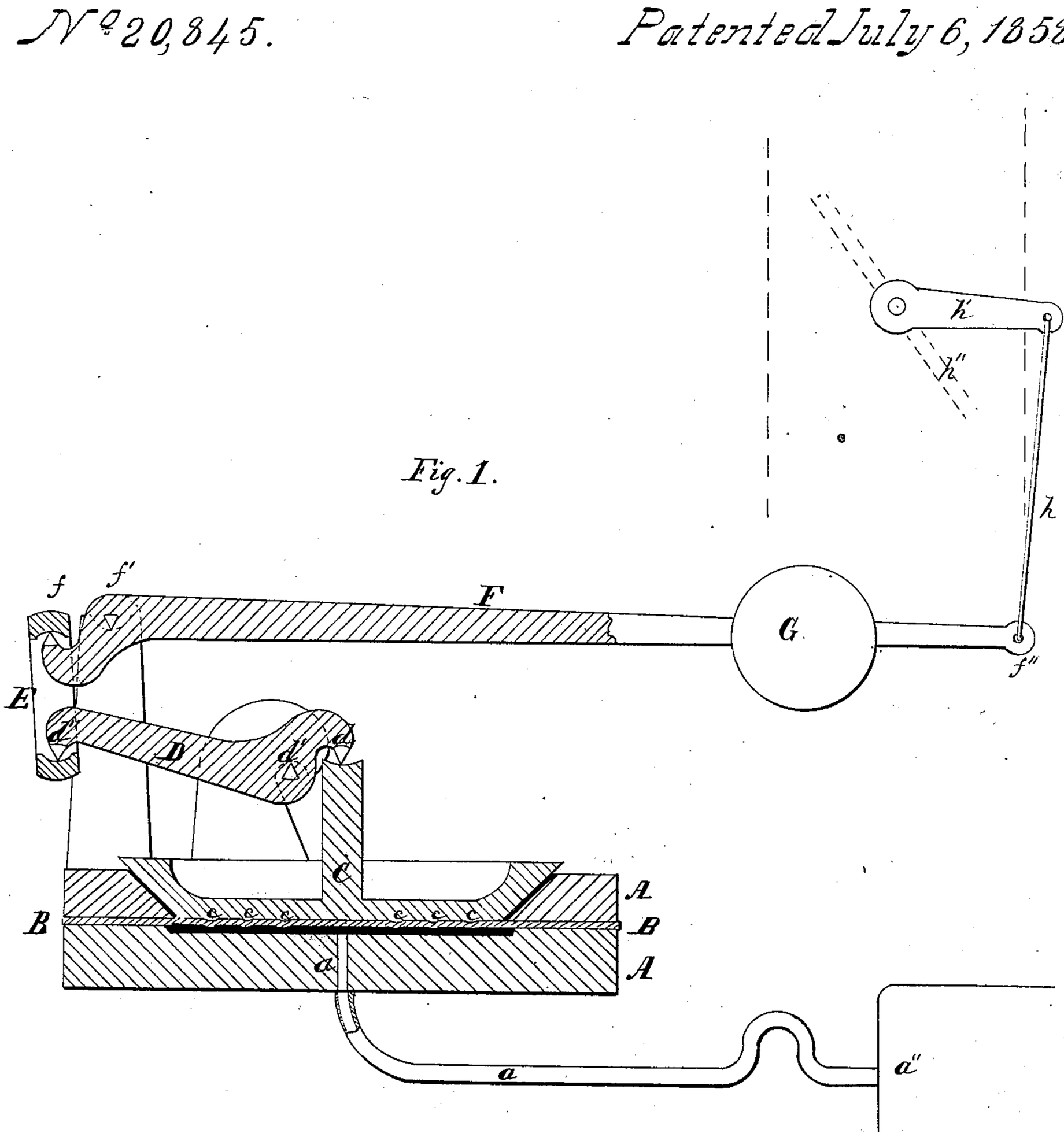
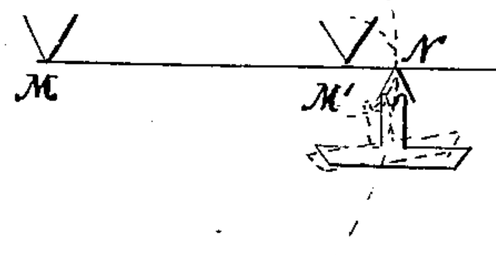


Fig. 2.



Inventor:
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UNITED STATES PATENT OFFICE.

WILLIAM S. GALE, OF NEW YORK, N. Y., ASSIGNOR TO HIMSELF, ALFRED A. VALENTINE, AND WILLIAM H. BUTLER, OF SAME PLACE.

IMPROVED VALVE-REGULATOR.

Specification forming part of Letters Patent No. **20,845**, dated July 6, 1858.

To all whom it may concern:

Be it known that I, WILLIAM S. GALE, of the city and county of New York, in the State of New York, have invented a new and Improved Steam and Fire Regulator for Steam-Boilers; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 represents a general vertical section through the whole, and Fig. 2 is merely an explanatory diagram.

My invention relates to that class of steam and fire regulators in which a flexible diaphragm is employed.

In my regulator, as in all other regulators of this class, the diaphragm is exposed to the varying pressure of the steam on its under side and to the gravity of a load on the upper side, so that it rises and sinks with each change of pressure, and thus through the agency of proper mechanism controls the draft of the furnace, partially closing the damper when the pressure rises too high and opening it wide when it sinks too low.

The nature of my invention consists in the combination of a plane diaphragm and plane load-piece with a compound lever in the manner represented in the drawings, so that the load-piece has but a very slight vertical movement and but a very slight oscillatory or rolling motion. This obviates the necessity for any slack around the edges of the load-piece, and thus prevents the rapid destruction of the material which results from the great bending and straining of the diaphragm in all other regulators.

The nature of my invention further consists in providing in addition to the above a fixed support to receive the load-piece (when it tends to descend too low) and to support it by its edges in the manner represented without diminishing the effective area of the diaphragm. In all other regulators the load tends to stretch the diaphragm so soon as the supporting-pressure of the steam below is taken away, and the only preventive thereof heretofore known has been to check the descent of the lever by some means; but as this leaves the parts loose, so that they are liable to derangement, it is not usually attempted; and the nature of my invention further consists in the use of slight projections on the lower face of the load-piece, which projections imprint themselves into the diaphragm, so that they prevent any slipping of the load-piece laterally upon the surface of the diaphragm.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation by the aid of the drawings.

A is the fixed bed slightly depressed in the center, as represented. *a* is an aperture therein. *a'* is the connecting-pipe, and *a''* is the boiler. The pipe *a'* and the aperture *a* form a free communication from the interior of the boiler to the depression in the upper side of A.

B is a diaphragm—a plane sheet of elastic material. I prefer india-rubber. It extends across the top of A and is tightly confined thereto at its edges.

C is a piece of metal resembling a safety-valve in form. This transmits to the diaphragm B a load, the manner of applying which will be presently described. When there is not sufficient pressure of steam in the boiler to overcome the load, the edges of C rest, in the manner represented, upon the seat formed by the ring A'. There are several small rounded projections *c c c* on the under surface of C, as represented, the purpose of which will appear below.

D is a lever in which are fixed three knife-edges *d d' d''*, as represented, *d'* being the fixed center or fulcrum.

E is a link connecting D to F.

F is a lever in which are fixed two knife-edges *f f'*, as represented, *f'* being the fixed center or fulcrum.

G is a weight attached to F. To the right extremity of F is connected the ordinary link or slender rod *h*, which extends to the lever or crank of the damper in the chimney.

Steam or water from the boiler flows through *a* and exerts its pressure on the under side of the diaphragm B, and through this tends to lift the load-piece C. The pressure thus transmitted tends to raise the extremity *d* of the lever D, and thus to depress the extremity *d''*. This effect is transmitted through E to

the levers F, tending to depress the extremity *f*, and thus to elevate the extremity *f''*, and through the agency of *h h'*, &c., to close the damper *h''*. The result is very obviously a rise of the weight G and a partial closing of the damper when the boiler-pressure is in excess and a sinking of G and a consequent opening of the damper when the pressure is too low.

My lever F, although differently mounted, is equivalent to the single lever used in other regulators of this class; but there has never heretofore been employed any equivalent of the additional lever D. It will be observed that the space from *d'* to *d''* is greater than from *d'* to *d*. The leverage of the weight G is therefore much increased by the employment of the lever D, so that a small weight G will allow a very large acting surface of the diaphragm B. Consequently a very slight motion of C will induce sufficient motion at the extremity *f''* of the lever F. This enables me to employ a plane diaphragm mounted in the manner represented instead of a dishing or bagging form.

The diaphragms employed in ordinary regulators are necessarily of a bag-like form in order to allow of the great motion of their respective load-pieces. The great bending and straining of the material thus employed induces its destruction in a few weeks or months. In my invention, on the contrary, this evil effect is not produced.

The extreme vertical movement of C in my invention is about one-eighth of an inch. This small amount of motion is allowed by the elastic nature of india-rubber without requiring any slack to be provided, and it results in practice that my diaphragm, which I prefer to make of vulcanized rubber without cloth, endures longer than those in any other regulator within my knowledge.

The projections *c c* serve to prevent C from slipping to one side of the center of the diaphragm. The pressure beneath B induces it to apply itself very closely to the whole under surface of C, and thus to bend or emboss itself, as represented. These bends, in connection with the peculiar method of applying the load, make the liability of C to slip laterally upon B very slight.

It must be observed that applying the load through the levers D and F, instead of through F alone, diminishes the tendency of C to move laterally. It is true that an equally small vertical movement of C can be made to produce an equally great vertical movement of *f''* by the use of a properly-divided single lever; but the same useful effect as mine cannot thereby be produced. In other words, my invention is not equivalent in this point to a simple change of proportions of other regulators. If the lever D be dispensed with and F be used alone, (the point *f* being fixed and the point *f'* connected to C,) either the arm *f' f''* must be made inconveniently long and cumbrous, or else the arm *f f'* must be made extremely short, so that the action of the knife-edges becomes defective. Aside from the practical differences between either such arrangement and my compound levers there is a substantial difference in the theory, for in case the arm *f' f''* of the single lever be lengthened the extremely-extended lever springs if slight and embarrasses the action by its inertia if stout. Either fault, or both, makes the action of the apparatus intermittent and uncertain. If, on the other hand, the arm *f f'* be shortened, the bearing-point of C does not move so nearly vertically as in my invention. This is illustrated by Fig. 2, in which N is the bearing-point of C, and M N the space allowed by my invention to intervene between such bearing-point *d* and the fixed fulcrum *d'*. As C rises and sinks, the bearing-point describes a small arc of a large circle—an action nearly equivalent to rectilinear motion; but if the fixed center be changed to M' (as would be necessary to effect the substitution in question) the same vertical motion of C would by reason of its bearing-point traveling in a smaller circle induce a greater lateral motion of its bearing-point. The black outline in Fig. 2 shows the action of my invention. The red shows the result of the attempt to produce an equivalent action with a single lever.

I give a conical form to the circumference of the load-piece C and a corresponding form to the interior of A and adapt each to the other in the manner represented in order that when the pressure in the boiler is too low to support the load the load-piece will rest on the ring A', and thus relieve the diaphragm from strain, and also in order that the load-piece C may as the pressure declines be restored to its proper position in the center of the diaphragm in case it should by any chance have been moved to one side. In the latter case the load-piece will on sinking touch one side of the ring A' and be deflected toward the other side, slightly stretching the diaphragm on one side to effect this movement. So soon, however, as the pressure declines to nothing, so the adhesion of B to C becomes very slight, the elasticity of B restores its parts to their first position. The ring A' therefore serves not only as a support to C in a certain position, but as a corrector of its position laterally.

It is essential to the success of a plane diaphragm that the load be transmitted through compound levers in lieu of a single one for the reasons above given, and it is almost equally essential that the load-piece be allowed to descend but a very small distance below the edges of the diaphragm and be rigidly supported in the proper position when the pressure of the steam is removed in order to avoid the violent straining of the diaphragm, which would result from a neglect of this precaution, and without perforating the diaphragm or allowing any slack at the edges it is desirable to provide some means

of securing a sufficient adhesion of the load-piece C to the diaphragm B to prevent the former from slipping laterally upon the latter.

I am not aware that any one has before used or invented either of these features of my invention.

What I claim as my invention, and desire to secure by Letters Patent, therefore, is—

In combination with the plane diaphragm B, corresponding load-piece C, compound lever D E F, and the support A′, the projections or ridges *c c* on the under surface of the load-piece and the printing of the shape of the same into the diaphragm for the purpose of preventing the slipping of C laterally upon B, as within set forth.

WILLIAM S. GALE.

Witnesses:

THOMAS D. STETSON,
GEO. F. HYATT,
EDWARD A. MAGEE.