No. 693,590. Patented Feb. 18, 1902.

J. CRANE, JR.

GAS BURNER.

(Application filed June 26, 1901.)

(No Model.)

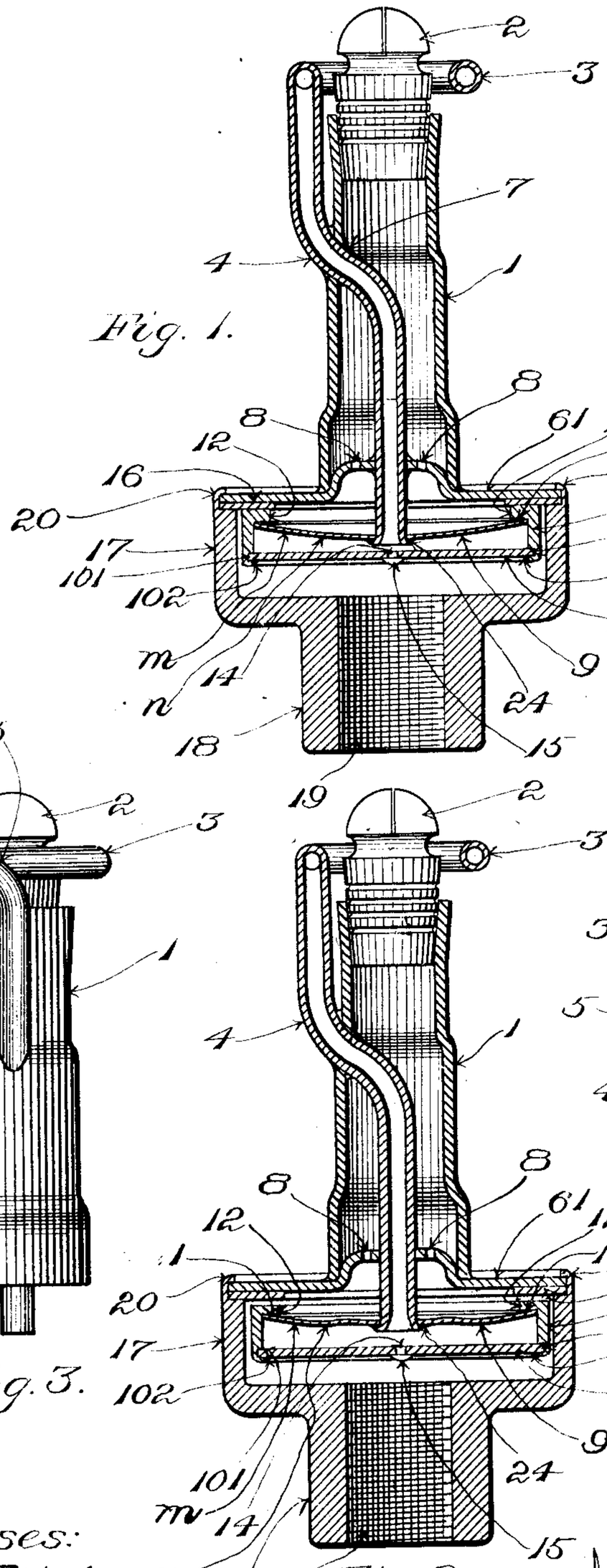

Fig. 1.

Fig. 3.

Fig. 2.

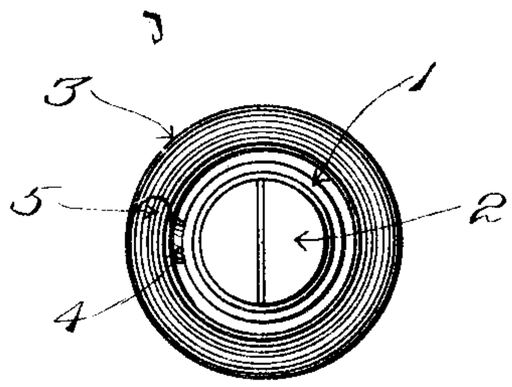

Fig. 4.

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UNITED STATES PATENT OFFICE.

JOSHUA CRANE, JR., OF WESTWOOD, MASSACHUSETTS.

GAS-BURNER.

SPECIFICATION forming part of Letters Patent No. 693,590, dated February 18, 1902.

Application filed June 28, 1901. Serial No. 66,093. (No model.)

To all whom it may concern:

Be it known that I, JOSHUA CRANE, Jr., a citizen of the United States, residing at Westwood, in the county of Norfolk, State of Massachusetts, have invented a certain new and useful Improvement in Gas-Burners, of which the following is a specification, reference being had therein to the accompanying drawings.

The burner herein described and shown is an improvement on that patented to W. J. Dudley by United States Patent No. 568,130, issued September 22, 1896.

The invention will first be described with reference to the accompanying drawings, which illustrate the best embodiment thereof yet devised by me, and afterward the essential characteristics of the invention will be particularly pointed out and distinctly defined in the claims at the close of this specification.

In the drawings, Figure 1 is a vertical cross-section of the burner in its closed condition. Fig. 2 is a similar section of the middle portion of the burner, showing the burner in its open condition. Fig. 3 is a view in elevation, showing the tip of the burner and adjacent parts. Fig. 4 is a plan view of the same.

In the drawings, 1 designates the pillar or burner-tube, in the upper end of which is inserted the usual tip 2. 3 is the annular heating-chamber surrounding said tip, and 4 is the pipe leading therefrom downwardly to the valve, hereinafter more particularly described. The first feature of the present improvement relates to the connection between said annular heating-chamber and pipe. In the patent above referred to the parts are described as separately formed and brazed together. I have made repeated experiments to produce such a construction expeditiously, cheaply, and with the certainty of obtaining a tight joint. The final outcome of such experiments has been the production and adoption of the arrangement illustrated herein. In this arrangement the annular heating-chamber is formed of an integral extension of the pipe 4, bent to a circular form of the required diameter and having its extremity 5 pinched up, brought into contact with the initial bend 6 of the pipe, and brazed thereto, such brazing serving not only to secure said extremity to said bend, and thus stiffen the heating-chamber to prevent its being bent in handling or by thermal action when in use, but also to seal said end hermetically.

The pillar is mounted on a supporting-disk 61, the lower edge of the said pillar fitting down over a central projection or boss, which is struck up from such disk when the latter is stamped out, and the parts being soldered together. The connecting-pipe 4 passes into the interior of the pillar, as at 7, where it is soldered thereto, and runs down centrally through a hole in the disk 61. The said disk therefore serves to hold the pipe from lateral displacement. Perforations 8 are formed in the disk surrounding said pipe for the admission of gas into the pillar.

An elastic diaphragm 9 is set in a ring 10 and is secured thereto by solder 11. The ring 10 has an inwardly-projecting flange 12, and the solder 11 is applied between such flange and the marginal portion of the diaphragm. The diaphragm has a central hole to receive the lower extremity of the pipe 4 and is applied to the latter, as shown, the end of the pipe being reamed out to prevent its withdrawal and the said parts being soldered together, as at 24, to form a tight joint between them and maintain the diaphragm firmly supported by the pipe. The ring 10 has its lower inner edge rabbeted to receive a disk or bottom piece 13. The bottom piece 13 is applied, the rim of the ring, as at 101, is spun over the edge of the bottom piece, and solder is used, as at 102, to seal the joint. Said bottom piece, ring, and diaphragm together form a diaphragm-chamber. A small hole is formed in the bottom piece 13, through which the diaphragm-chamber, pipe 4, and annular heating-chamber 3 are filled with a liquid of low boiling-point, and said hole is then closed by a plug 14 and a drop of solder 15.

When the parts above mentioned are first assembled, the diaphragm 9 is so applied and affixed to the extremity of the pipe 4 that the upper face of the flange 12 of the ring 10 shall come in contact with the under surface of the disk 61. After the diaphragm-chamber has been completed and filled heat is applied to volatilize a portion of the contained fluid, which, as will of course be understood,

throws the diaphragm-chamber away from the disk 61, as shown in Fig. 2, by reversing the curvature of or, in other words, convexing, the middle portion of the diaphragm. While the disk and diaphragm-chamber are thus separated, an annular leather washer 16 is inserted between them by being temporarily elongated and slipped over the diaphragm-chamber and then restored to form and seated against the disk. The outer diameter of said washer is the same as the diameter of the disk 61. Now when the burner is allowed to cool the diaphragm-chamber or, more precisely speaking, the upper surface of the flange 12 of the ring 10, will be forced by the self-recovering action of the diaphragm (hereinafter explained) up into close gas-tight contact with the washer. In the above position, as will of course be understood, the diaphragm-chamber acts as a valve to close completely the burner to the passage of gas into the pillar, while in the position shown in Fig. 2 the valve is opened and free passage of gas is permitted.

17 is a cup adapted to support the parts hereinabove described and to inclose the diaphragm-chamber. 18 is a hollow neck projecting centrally downward from said cup and interiorly screw-threaded, as at 19, for attachment to the bracket or other support to which the burner is to be affixed. The inner edge of the cup is rabbeted to receive the disk 61, and when the latter has been put in place the rim 20 of the cup is spun over upon the margin of the disk, thus clamping the two together. As will be observed, the outer margin of the packing 16 is interposed between the cup and disk. Thus the said packing is made to serve the double function of closing the joint between the cup and disk and of serving as a seat for the valve constituted by the diaphragm-chamber. The most important aim which I have had, however, is to render practicable the employment of a "spring-metal diaphragm." It is not intended by this term to include metal diaphragms having a slight and incidental resistance to flexure, but a tempered-metal disk capable of fully recovering its original shape after being flexed without the uncertain aid of springs or air-pressure. Air-pressure is of course present and exerts some tendency to assist the restoration of shape of the diaphragm upon decrease of fluid-pressure within the diaphragm-chamber; but in my device the diaphragm, as just stated, has the property of recovering its original shape wholly independently of the said air-pressure, and hence can be positively depended upon to perform its intended function. The capability just referred to may be briefly expressed as that of "self-recovery," and a diaphragm having that capability may be termed a "self-recovering" diaphragm. The superiority of such a diaphragm will upon consideration be apparent. It reduces the mechanism of the burner to a minimum. In my burner there are neither loose nor sliding nor pivoted parts. The employment of such diaphragm also renders the burner sure of operation. Not only is the diaphragm of my burner self-recovering when flexed, but in its position in the assembled device and subject to the conditions of actual use it exerts such force in the action of self-recovery as to close very firmly the valve which it actuates, and thus to prevent with certainty the undesired and dangerous escape of gas, while its amplitude of motion is quite adequate to secure a clear passage for gas when the flame thereof is burning.

The firm closing of the valve just mentioned is always essential, but is especially difficult of attainment where the advantage of a packing interposed between the valve and its seat is sought to be secured, as in the arrangement herein shown and already described, for with such construction it is not sufficient that a merely physical contact between the valve and the packing should take place. On the contrary, it is necessary for the production and maintenance of a gas-tight closure that the valve after making contact with the packing shall be drawn against the latter with considerable force. Upon the flexure of the diaphragm the packing is relieved of compression and exhibits a certain degree of expansion, thereby following up the motion of the diaphragm-chamber to a material extent, still keeping the burner substantially closed to the passage of gas. For this reason it requires a diaphragm of considerable amplitude of motion to separate the valve which it actuates completely from such packing, and thereby to permit a free passage of gas to the burner-tip. This action, however, is readily secured with the diaphragm herein described.

In using the term "metal," however, I do not confine myself to the use of what is ordinarily known as a metal if there be other substances capable of a similar action in regard to resiliency and adaptation to use in a burner such as herein described.

To obtain the advantages enumerated above, I preferably employ a concave or dished diaphragm of spring-brass. It is only, however, after continued experiment and consideration that I have been able to produce in quantity and with an intelligent understanding of the conditions of practical success spring-diaphragms having the property of self-recovery. I have finally ascertained that in order that such diaphragm may be self-recovering its surface must have a curvature not exceeding a certain predetermined amount—that is to say, that when less than said curvature is imparted the diaphragm takes on the additional quality of self-recovery, which it does not possess if characterized by a greater curvature. To avail myself of this property, which, so far as I am aware, is of my own discovery, I employ tools or machinery to produce the curvature or dishing of the diaphragm which is so propor-

tioned as to give the latter a trifle less than the degree of concavity mentioned.

The normal position of the diaphragm is indicated in Fig. 1, while its position during the time the burner-flame is present is indicated in Fig. 2. Something may be observed in the way of explanation of the property of self-recovery, although such explanation is only tentatively offered. It appears that the effort of the annular portion of the diaphragm (marked *m* in Fig. 2) is exerted to draw the interior area *n* back into its original position of concavity, but that such tendency has to act against the resistance of the fullness of the metal in the said interior area to being so drawn or crowded back. Now I have found that if the fullness is greater than a certain amount by the curvature of the diaphragm exceeding a certain degree such withdrawal will not be effected, but the displacement of the diaphragm will become permanent. It will also be evident, as before intimated, that the force with which the diaphragm-chamber (or more precisely the upper surface of the flange 12 thereof) is drawn against the packing 16 when the diaphragm has recovered itself into the position shown in Fig. 1 is ample to produce a gas-tight closure between said parts, the diaphragm then being in its extreme position of concavity and all its portions acting to augment such pressure.

What I claim is—

1. In a burner, the combination of a burner-tube, a support therefor, a thermally-operated valve for controlling the flow through said burner-tube, a pipe leading from the operating mechanism of said valve into proximity to the burner-tip, and an annular heating-chamber surrounding said tip and formed by an integral extension of said pipe, having its extremity closed and brazed to the intermediate portion of the pipe, whereby the said extremity is both hermetically sealed and secured from displacement.

2. In a burner, the combination of a burner-tube, a disk on which the same is mounted, a diaphragm-chamber below the disk, and a pipe leading upward from the diaphragm-chamber fitting a hole in the disk and extending into proximity to the tip of the burner-tube, whereby the said disk is caused to support or steady the lower end of the said pipe and diaphragm-chamber.

3. In a burner, the combination of a burner-tube, a disk supporting the same, a cup having a rabbeted edge receiving the disk and a turned-over rim to secure the disk in place, and a packing interposed between the cup and disk.

4. In a burner, the combination of a burner-tube, a disk, a cup to which the disk is attached, a valve within the cup, adapted to move toward and from the disk, and an annular packing the outer margin of which is interposed between the cup and disk while the inner margin extends between the valve and disk.

5. In a burner, the combination of a burner-tube, a disk, a cup to which the disk is attached, a diaphragm-chamber located within the cup, a pipe leading from a point in proximity to the flame of the burner through the disk, and affixed to the diaphragm of the diaphragm-chamber, whereby the latter is centrally supported, and an annular packing the outer margin of which is interposed between the cup and disk while the inner margin extends between the disk and diaphragm-chamber.

6. In a burner, the combination of a burner-tube, a valve for controlling the flow of gas therethrough, and actuating means for automatically opening and closing said valve, including a concave spring-metal diaphragm subjected to thermally-affected fluid-pressure on its convex side, said diaphragm having its marginal portion secured and being self-recovering upon decrease of the aforesaid fluid-pressure.

7. In a burner, the combination of a burner-tube, a valve for controlling the flow of gas therethrough consisting of a movable chamber, and having one wall thereof formed by a concave spring-metal diaphragm secured at its margin, and a pipe leading from a point in proximity to the burner-flame to the said chamber, the said diaphragm receiving said pipe at its center and being self-recovering upon decrease of pressure within the diaphragm-chamber.

8. In a burner, the combination of a burner-tube, a valve for controlling the flow of gas therethrough consisting of a movable chamber having an inturned flange, and having one wall thereof formed by a concave spring-metal diaphragm, and a pipe leading from a point in proximity to the burner-flame to the said chamber, the said spring-metal diaphragm receiving said pipe at its center, having the marginal portion thereof affixed to said inturned flange, and being self-recovering upon decrease of pressure within the diaphragm-chamber.

In testimony whereof I affix my signature in presence of two witnesses.

JOSHUA CRANE, JR.

Witnesses:
LEPINE HALL RICE,
ROBERT WALLACE.