Jan. 17, 1939. P. L. BETZ ET AL 2,144,399

SAFETY DEVICE FOR GAS BURNERS

Original Filed Nov. 24, 1933 2 Sheets-Sheet 1

Fig. 3.

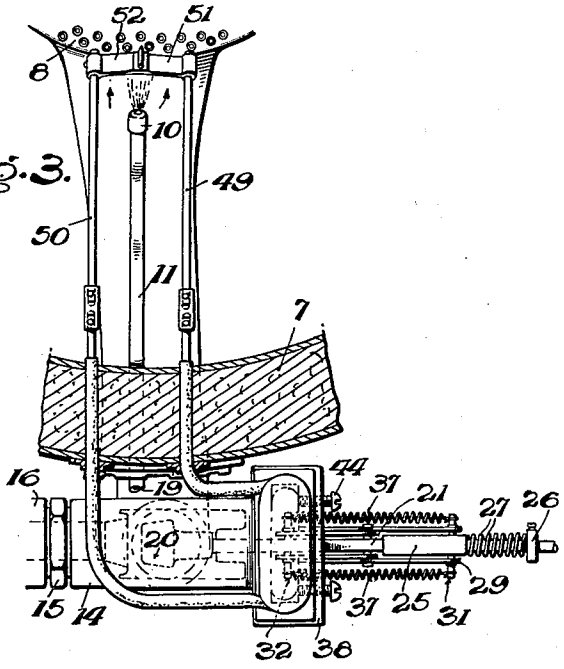


Fig. 1.

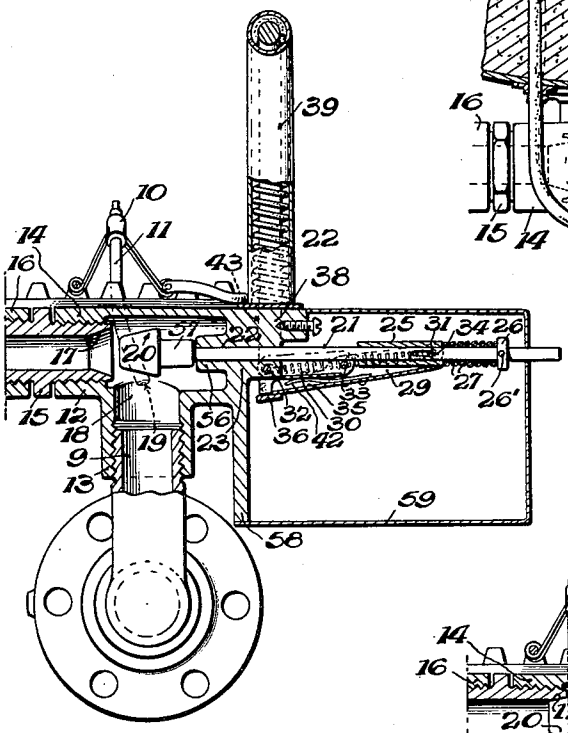
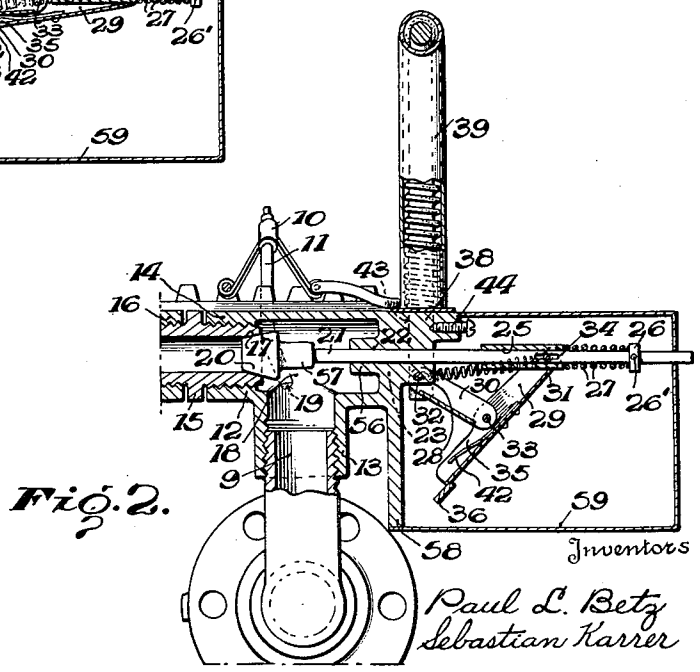


Fig. 2.



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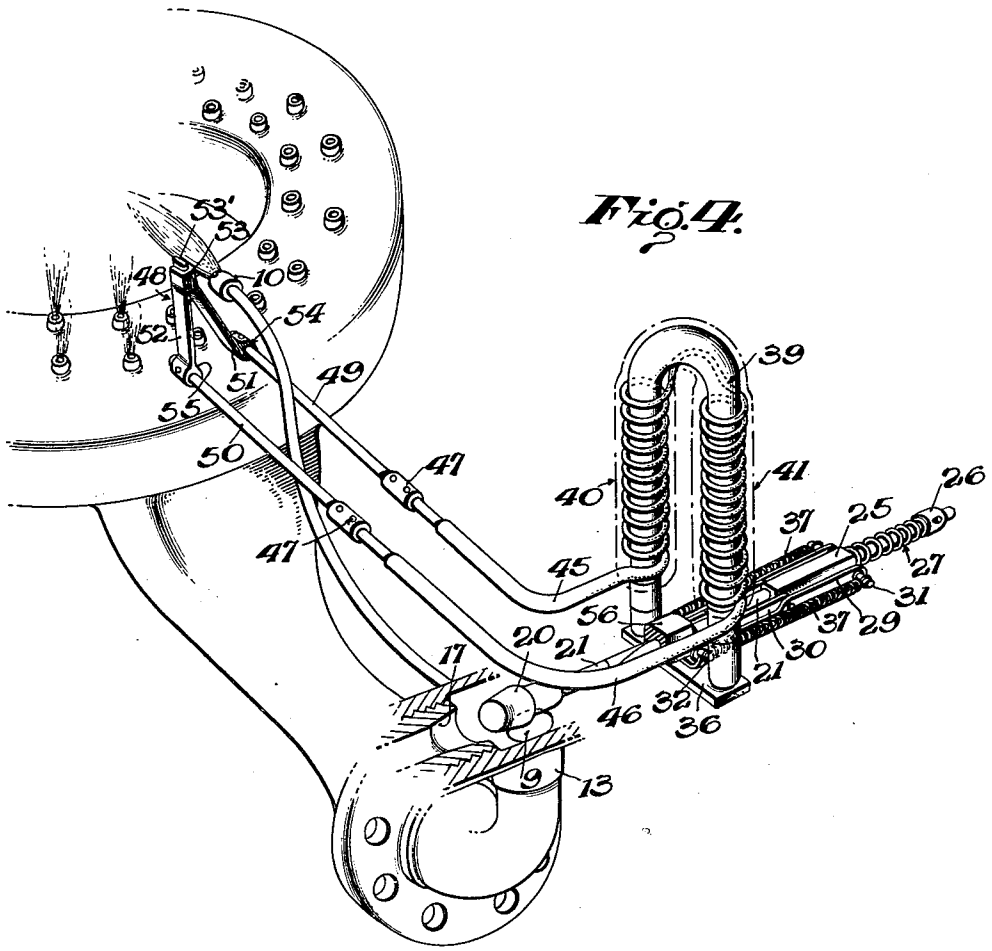
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Original Filed Nov. 24, 1933 2 Sheets-Sheet 2

Fig. 4.



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UNITED STATES PATENT OFFICE

2,144,399

SAFETY DEVICE FOR GAS BURNERS

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Original application November 24, 1933, Serial No. 699,590. Divided and this application October 1, 1937, Serial No. 166,670

13 Claims. (Cl. 137—139)

This invention relates to a safety device, and more particularly to a safety device for gas burners whereby a valve in the gas line will be closed automatically whenever a flame to which it is subjected, as a pilot flame, goes out.

In the application of Sebastian Karrer, Serial No. 547,977, filed June 30, 1931, for "Safety device for gas burner", a device of the type characterized has been disclosed which permits the use of a relatively small valve that can be opened wide, thereby avoiding the use of valve members with only a relatively small lift with respect to their seat and the consequent need for a relatively large valve port in order that the desired flow of gas therethrough can be maintained, which may be removed from the burner to any suitable extent and disposed either above or below as well as in the plane of the burner without interfering with its sensitivity or reliability, and which uses the principle of a thermoelectric couple and an electromagnet energized by said couple to hold the valve in open position as long as the flame to which the couple is subjected is maintained but effecting a prompt closure of the valve when the flame goes out.

It is an object of this invention to provide an improved device of the character above described in which the force available for maintaining the valve in its open position is less than the force that is ultimately available for closing the valve but in excess of that normally tending to close the valve under normal conditions.

Another object of this invention is to provide an improved device of the type characterized wherein the electromagnet and its armature are removed from the passages through which the gas flows.

Another object of this invention is to provide an improved device of the type characterized wherein all movable parts, except the valve member and its stem, are removed from the passages through which the gas flows.

Another object of this invention is to provide an improved device of the type characterized wherein the electromagnet, its armature, and its associated operating mechanism are disposed exteriorly of the casing containing the valve mechanism.

Another object of this invention is to provide an improved device of the type characterized wherein the valve member is so actuated that when the valve is to be closed it is positively and firmly pressed into close contact with its seat by resilient means cooperating with the stem of the valve and which therefore enables the valve to be installed so that it closes against the gas pressure as well as with the gas pressure, as may be preferred.

Another object of this invention is to provide an improved device of the type characterized wherein the valve member may be so constructed and arranged that when opened leakage along its stem is prevented without need for a gland around said stem.

Another object of this invention is to provide an improved device of the type characterized wherein the various parts composing the electromagnet, its armature, and its operating mechanism may be constructed of simple elements that may be readily standardized and that are inexpensive to fabricate and assemble.

Another object of this invention is to provide an improved device of the character above described which is simple in construction, inexpensive to manufacture and certain in operation.

Other objects will appear as the description of the invention proceeds.

The invention is capable of receiving a variety of mechanical expressions, one of which is shown on the accompanying drawings, but it is to be expressly understood that the drawings are for purposes of illustration only and are not to be construed as a definition of the limits of the invention, reference being had to the appended claims for that purpose.

Referring in detail to the drawings, wherein the same reference characters are employed to designate corresponding parts in the several figures.

Fig. 1 is an axial section through a valve mechanism embodying the present invention;

Fig. 2 is a view corresponding to Fig. 1 but showing the valve in closed position;

Fig. 3 is a plan view of the device; and

Fig. 4 is a perspective view of the valve and its operating mechanism.

The invention can be embodied in a wide variety of constructions for use with a wide variety of devices employing gas burners, but for purposes of illustration the invention has been shown as embodied in a device for automatically closing a valve in a gas line leading to the burner of a hot water heater 7 whenever the pilot of said heater goes out. The main burner is indicated at 8 and may be of any suitable construction. Said burner is supplied with gas through pipe 9, and the gas supply line may be provided, as is more or less common, with a valve under the control of a thermostat, of any suitable construction (not shown), in order that said valve may be

actuated and gas supplied to or shut off from said burner as required to maintain the temperature of the water between predetermined limits. Also associated with said burner 8 is a pilot 10 of any suitable construction and supplied with gas through pipe 11.

In accordance with the present invention the flow of gas to the main burner 8 is to be automatically and promptly stopped whenever the pilot flame goes out, the pipe 11 leading to the pilot 10 communicating with the main gas conduit on the inlet side of and ahead of the thermostatically controlled valve. As shown, a generally T-shaped valve casing 12, of any suitable size, construction and material, and which may be a brass or aluminum casting, is mounted in the main gas line, said casing having the stem of its T formed as an outlet nipple 13 with which the pipe 9 leading to the main burner is coupled in any suitable way, as by a screw threaded coupling. The arm 14 of said T-shaped housing is suitably constructed to constitute or receive a seat for the valve member. As shown, the casing is interiorly threaded at 14 and receives a coupling member 15, of any suitable material such as brass or aluminum, which is exteriorly threaded for engagement with the threads 14, at one end, and at its opposite end said coupling member 15 is threaded or otherwise suitably formed for connection with the gas inlet pipe 16. Member 15, in the form shown, has its inner end coned or otherwise suitably formed so as to form a valve seat 17.

Cooperating with said valve seat 17 is a valve member 20 of any suitable construction and material and formed on or attached to a valve stem 21 which has a sliding fit in an aperture 22 formed in the end wall 23 that closes the end of the opposite arm of the T-shaped casing. Exteriorly of said casing valve stem 21 has slidably mounted thereon a sleeve 25, preferably rectangular in external configuration, although if preferred said sleeve may have any other suitable form. Mounted on the outer end of said valve stem is a collar 26, which may be retained thereon in any suitable way as by a pin or set screw 26', and interposed between said collar 26 and said sleeve 25 is a coil spring 27 which normally urges said sleeve inwardly with respect to said stem but which may yield as hereinafter described.

Formed on or suitably attached to the end wall 23 of said casing is a suitable support 28 for one of the pivots of a toggle mechanism next to be described. As shown, said support is in the form of a lug projecting outwardly from the wall 23 and having an aperture therethrough in alinement with the aperture 22. Pivotally attached to the sleeve 25 and to the support 28 are the two arms 29 and 30 of a toggle, arm 29 being pivoted on sleeve 25 at 31, with said pivot pin passing through an elongated slot 34 in stem 21, arm 30 being pivoted on support 28 at 32, and the two arms being pivotally connected at 33. Said toggle arms may be formed in any suitable way. As shown, each is formed of sheet metal, such as brass stamped or otherwise suitably formed into members of U-shaped or trough-shaped cross section. Member 29 has its trough of sufficient width so that the arms thereof embrace the sleeve 25, and the pivot pin 31 is passed through the sides of said trough and said sleeve as well as the slot 34 in the stem 21. Arm 30 has its trough of sufficient width so that its sides are received within the trough of arm 29, and pivot pin 33 is passed through said overlapping sides. The trough of arm 30 is also of such width that it embraces the lug 28 and pivot pin 32 passes through the sides of the trough 30 and said lug.

Arm 29 has an extension 35 beyond the pivot 33 and suitably attached to the end thereof, as by solder, is a flat bar-shaped armature 36, preferably of high permeability. Cooperating with said toggle mechanism is suitable resilient means for normally urging the toggle arms to angular relationship, as shown in Fig. 2. Said resilient means may be provided in any suitable way, but are shown as composed of a pair of coil springs 37 connected at their opposite ends to the pivot pins 31 and 32 and retained thereon in any suitable way. Also interposed between the extension 35 and arm 30, and here shown as suitably attached to extension 35, is a leaf spring 42 which engages the arm 30 and is tensioned thereby. Hence spring 42 provides an initial force to move the toggle arms off dead center when the armature is released.

Projecting axially from the end wall 23, and suitably attached thereto or formed thereon, is a transversely extending flange 38 which constitutes a support for the electromagnet. Said electromagnet may be of any suitable size and construction, but for simplicity it is preferably formed as follows: A U-shaped bar 39 of iron, preferably of high permeability and shown as on the order of 3/8" in diameter, has coils 40 and 41 wound on its two legs and composed of wire of relatively low resistance, on the order of .125" in diameter, each coil being composed of a suitable number of turns, on the order of twenty. Said coils may be wrapped with any suitable insulating cover. Flange 38 is provided with a pair of apertures 43 which are spaced in conformity with the spacing of the legs of the U-shaped core of the electromagnet, and said electromagnet is supported in said flange by projecting the ends of the legs through said apertures 43, after which said legs may be secured in said apertures in any suitable way, as by set screws 44. The ends of said core are thus located below the flange 38 as viewed in the drawings, and are positioned to be engaged by the armature 36 when the parts are in the relative position shown in Fig. 1, the end faces of the core end providing pole faces of relatively large area for contact with the armature.

The leads 45 and 46 from the electromagnet coils extend toward the pilot 10 and may be bent or curved to any suitable extent. Said leads are connected to a thermoelectric couple unit generally designated 48. As shown, said unit is composed of a pair of conducting arms 49 and 50, which may be made of the same material and size as the wire constituting the coils of the electromagnet provided that sufficient rigidity of the arms is thus effected, and said arms are detachably connected to the leads 45 and 46 respectively by couplings 47 of any suitable character. Suitably attached to the ends of the arms 49 and 50 are the two members 51 and 52 of the thermoelectric couple having a junction at 53, preferably having a suitable flame resistant extension 53' of an intermediate metal which is directly subjected to the action of the flame. Said thermoelectric couple may be formed of any suitable material, such as Chromel-Constantin. The arms 49 and 50 are of such length and extend in such a direction as to dispose the junction 53 or its flame resistant extension 53' in

the flame of the pilot 10. As said arms may be made of any suitable length, the valve casing 12 with its associated parts may be disposed at any suitable distance from the main burner 8 and pilot burner 10 so as to remove the valve casing and its associated parts from the zone of high heat around the burner. The members 51 and 52 may be of any suitable length to maintain the proper temperature differential between the junction 53 and the opposite ends of said members in order to obtain the desired thermoelectric current, but as the material of the terminals 51 and 52 is ordinarily relatively expensive the junctions 54 and 55 are preferably made as close to the junction 53 as is consistent with the maintenance of a proper difference in temperature therebetween. Convection and radiation as well as conduction along arms 49 and 50 are here relied on for maintaining the proper temperature at the junctions 54 and 55, but any suitable means may be provided for maintaining these junctions properly cooled.

If preferred one of the junctions 54 and 55 may be made closer to the junction 53 than the other, or it may be so constructed that it tends to retain its temperature longer than the junction 53, so that when the pilot light goes out junction 53 will cool before the last referred to junction, and thereby a reversal of the thermoelectric current will be obtained through the coil of the electromagnet to the end that the latter may be completely demagnetized. Such a construction, however, is ordinarily unnecessary, particularly where means are provided for normally urging the armature away from the end of the electromagnet as here illustrated and described.

Any suitable means may be provided for preventing escape of gas from the interior of the casing 12 along the valve stem 21 in accordance with the broader features of the present invention but this function is preferably performed by the valve member 20. As here shown the end wall 23 has an inwardly extending tubular boss or projection 56 surrounding the valve stem, and the valve member 20 has a rearwardly extending portion 57, of a diameter greater than that of the valve stem 21, for engagement with the end of the tubular boss 56. When the valve is closed, as shown in Fig. 2, the end faces of tubular boss 56 and valve portion 57 are spaced by the amount equal to the total movement when opening the valve but somewhat less than the movement required at the sleeve 25 for straightening out the toggle arms 29 and 30 and engaging the armature 36 with pole faces of the electromagnet. Hence, when the valve is opened, as hereinafter described, the end faces of the portions 56 and 57 engage each other, and they are preferably machined or otherwise formed so as to provide a contact that will prevent passage of gas therebetween and along the stem 21 through aperture 22. If preferred, however, the extension 57 on the valve member may be of such length as to cooperate with the inner face of end wall 23, or the tubular boss 56 may be of such length as to cooperate with the rear face of the valve member 20 to effect the same function.

Means are also preferably provided for enclosing the projecting end of the valve stem and its toggle mechanism so that these parts will be protected against injury from accidental impact, and if desired, said enclosure may be locked. As shown, the casing 12 has, either attached thereto or formed as an integral extension of the end wall 23, a generally rectangular skirt 58 which may constitute a support and means for attachment of a generally rectangular housing 59 that may be telescoped over the operating parts, as shown in Figs. 1 and 2, and suitably attached to the support 58, with or without a lock as preferred.

In operation, and assuming that the pilot is lighted, the flame at the junction 53 or extension 53' maintains a thermoelectric current through the electromagnet and the armature 36 is held against the poles of the core 39, in the position shown in Fig. 1. This condition is maintained as long as the pilot is lighted, and gas can flow freely through the port 17 to the main burner. If the pilot light goes out the thermoelectric current through the electromagnet ceases and the valve stem is free to be moved by springs 42, 27 and 37 so as to engage valve member 20 with the valve seat 17 and stop further flow of gas through the latter.

When the valve member 20 is moved to open position, as by pressing the armature 36 or its arm 35 toward the electromagnet, valve stem 21 slides rectilinearly through the aperture 22, following the motion of sleeve 25, and the toggle arms 29 and 30 are moved from the position shown in Fig. 2 toward the position shown in Fig. 1. Before armature 36 engages the poles of the electromagnet, however, extension 57 on valve member 20 engages tubular boss 56 and further outward movement of the valve stem is stopped. Further straightening of the toggle arms, to the position shown in Fig. 1 wherein the armature 36 engages the poles of the electromagnet, causes the sleeve 25 to move outwardly on the stem 21, as permitted by the slot 34 for the pivot 31, against the tension of the spring 27. Thereby the end faces of the members 56 and 57 are drawn into tight contact and are placed under considerable tension, so that they constitute an effective valve to prevent leakage of gas along the valve stem 21. By preference the arms 29 and 30 are in alinement when the armature 36 is against the pole pieces, so that no component of the force of the spring 37 and 27 must be overcome by the pull of the electromagnet on its armature. Spring 42, however, exerts a pressure against toggle arm 30 when the toggle arms are in alinement and tends to move said arms off dead center when the armature is released.

When the pilot goes out and by reason of the action of the thermocouple an electric current is no longer generated to energize the electromagnet, spring 42 which is under stress tends to move the toggle arms into angular relationship. As soon as the toggle arms are in angular relationship springs 27 and 37 move sleeve 25 to decrease the angle until pivot pin 31 strikes the end of slot 34 with something of an impact. Thereafter the springs 37 exert their tension on the valve stem to decrease the angle between said toggle arms and move the valve stem and its valve member inwardly until the valve member engages the valve seat 17, the impact of the pin 31 at the end of the slot 34 tending to overcome any tendency of the valve to stick in open position. Said coil springs 37 are preferably so constructed and arranged that there is substantial residual tension in said springs when the valve member 20 has been engaged with its seat 17 so that said valve member is firmly pressed

against said seat by the tension of said springs **37**.

After valve member **20** has been engaged with its seat **17** no gas can flow to the main burner until the valve is manually opened, and even then said valve cannot be retained in open position until the pilot has been lighted and a thermoelectric current generated by the action of the pilot flame on the thermoelectric couple. Hence the danger of gas escaping, with the resultant dangers of explosion, fire, gas poisoning, etc., is effectually prevented, while a further flow of gas can be obtained only by a deliberate manual manipulation of the valve and a continued flow can be obtained only by reestablishment of the thermoelectric current that exists during the normal operation of the pilot. To reopen the valve **20** the housing **59** must also be removed.

The construction described provides sufficient force between the armature **36** and the end faces of the core **39** to assure that the armature will be held firmly against the poles of the electromagnet during the normal operation of the device and premature or improper operation of the device will not be caused by jars, vibrations, small fluctuations in the magnitude of the electric current, etc.

It will therefore be perceived that a safety device has been provided by the present invention wherein the electromagnet and its armature as well as all of the movable and operating parts except the valve and its stem are positioned exteriorly of the gas passages. As the device may be positioned at any desired relationship with respect to the burner, and may be located as remote from the heat of the burner as desired, the parts thereof may be effectively insulated from the heat generated by the burner, and they may be composed of materials which might be injured if subjected to the zone of heat closely adjacent to the burner.

Furthermore, it will be perceived that all of the parts of the device built in conformity with the present invention are relatively simple in construction, inexpensive to manufacture and easy to assemble. The parts thereof can therefore be standardized for production in large quantities and at small expense by the use of relatively unskilled labor. At the same time the device is certain in operation, and while on the one hand the area of contact between the armature and the electromagnet poles is such as to assure against accidental and improper disengagement thereof, and the releasing tendency of the spring **42** is well within the force available for holding the armature against the poles, said spring assures operation of the toggle when the electromagnetic force ceases and thereafter closing movement of the valve is effected by a resilient force which may be materially greater than said electromagnetic force. The fact that the armature and electromagnet poles are removed from the path of the gas assures that corrosion or other action arising from contact with the gas will not cause adhesion or sticking of the parts and therefore interference with the proper and desired operation of the device. The electromagnet, armature and operating mechanism are thus fully exposed where they are readily accessible for inspection and operation, and at the same time they may be readily enclosed in a housing against injury. The valve may close against the gas pressure because it is positively moved into closed position and firmly pressed against its seat. At the same time the construction is such as to prevent leakage of gas therefrom if it is desired to avoid the use of packing glands or the like around the valve stem.

While one embodiment of the safety device has been illustrated and described with considerable particularity, it is to be expressly understood that the invention is not to be restricted thereto as the same is capable of receiving a variety of mechanical expressions, some of which will now readily suggest themselves to those skilled in the art, while changes may be made in the details of construction, arrangement, material and proportion of parts, and certain features may be used without other features, without departing from the spirit of the invention. Furthermore, while the invention has been illustrated and described as employed in conjunction with a pilot light, it will be apparent that the invention can also be used as a safety device in connection with other sources of heat to prevent the occurrences of dangerous conditions, as will now be apparent to those skilled in the art. Reference is therefore to be had to the claims appended hereto for a definition of the limits of the invention.

This application is a division of our application, Serial No. 699,590, filed November 24, 1933, for improvements in Safety devices for gas burners.

What is claimed is:

1. In a device of the character described, in combination with a gas valve having a casing, a valve member and a valve stem extending to the exterior of said casing, an electromagnet having an armature operatively connected to the valve stem and adapted to hold said valve open, means intermediate the valve member and the wall of the valve casing constituting a valve to prevent leakage of gas along the valve stem, a sleeve slidably mounted on the valve stem, a toggle mechanism operatively connecting said armature with said sleeve and valve stem, and resilient means cooperating with said sleeve and yieldable upon engagement of said means between the valve member and casing wall when said valve member is moved to open position to hold said means between said valve member and casing wall in contact under resilient tension while the valve is open.

2. In a device of the character described, in combination with a gas valve having a valve stem, an electromagnet having an armature operatively connected to the valve stem and adapted to hold said valve open, a sleeve slidably mounted on the valve stem, a toggle mechanism operatively connecting said armature with said sleeve and valve stem, resilient means cooperating with said toggle mechanism to initiate the braking movement of said toggle mechanism when said valve is to be closed, resilient means tensioned by the straightening of said toggle mechanism and cooperating with said sleeve to continue the braking movement of said toggle mechanism, and additional resilient means cooperating with said toggle mechanism to move said valve member into engagement with its seat.

3. In a device of the character described, in combination with a gas valve having a valve stem, an electromagnet having an armature operatively connected to the valve stem and adapted to hold said valve open, a sleeve slidably mounted on the valve stem, a toggle mechanism operatively connecting said armature with said sleeve and said valve stem, resilient means co-

operating with said toggle mechanism to initiate breaking movement of said toggle mechanism when said valve is to be closed, resilient means cooperating with said sleeve to move said sleeve relatively to said valve stem, a stop to limit said relative movement, and additional resilient means cooperating with said toggle mechanism to move said sleeve and valve stem as a unit after said stop has been engaged, the engagement of said stop under the action of the aforesaid resilient means acting as an impact to assure movement of said valve stem.

4. In a device of the character described, in combination with a gas valve having a valve stem, an electromagnet having an armature, a toggle mechanism operatively connecting said armature with said valve stem, said armature cooperating with said electromagnet to hold said valve open, the arms of said toggle being substantially aligned when said armature is held by said electromagnet, means for moving said arms into an angular relationship when said armature is released by said electromagnet, said means exerting a force on said armature which is materially less than the electromagnetic force exerted by said electromagnet on said armature and becoming inoperative before the final angular relationship of said arms is established, and separate means for actuating said toggle arms and moving said valve stem toward closing position after said arms have been moved into said angular relationship.

5. In a device of the character described, in combination with a gas valve having a valve stem, an electromagnet having an armature, a toggle mechanism operatively connecting said armature with said valve stem, said armature cooperating with said electromagnet to hold said valve open, the arms of said toggle being substantially aligned when said armature is held by said electromagnet, means for moving said arms into an angular relationship when said armature is released by said electromagnet, said means exerting a force on said armature which is materially less than the electromagnetic force exerted by said electromagnet on said armature and becoming inoperative before the final angular relationship of said arms is established, and separate means for actuating said toggle arms and moving said valve stem toward closing position after said arms have been moved into said angular relationship, said last named means being inoperative to move said toggle arms and valve stem while said armature is held by said electromagnet and adapted when rendered operative to exert a force on said toggle arms and valve stem which is materially greater than the electromagnetic force normally holding said armature.

6. In a device of the character described, in combination with a gas valve having a valve stem, an electromagnet having an armature, a toggle mechanism operatively connecting said armature with said valve stem, said armature cooperating with said electromagnet to hold said valve open, the arms of said toggle being substantially aligned when said armature is held by said electromagnet, a spring means reacting between said toggle arms for moving the same into angular relationship, said spring exerting a force on said armature which is materially less than the electromagnetic force exerted by said electromagnet on said armature and becoming inoperative before the final angular relationship of said arms is established, and separate spring means for actuating said toggle arms and moving said valve stem toward closing position when said arms have been moved into angular relationship by said first named spring means.

7. In a device of the character described, in combination with a gas valve having a valve stem, an electromagnet having an armature, a toggle mechanism operatively connecting said armature with said valve stem, said armature cooperating with said electromagnet to hold said valve open, the arms of said toggle being substantially aligned when said armature is held by said electromagnet, a spring means reacting between said toggle arms for moving the same into angular relationship, said spring exerting a force on said armature which is materially less than the electromagnetic force exerted by said electromagnet on said armature and becoming inoperative before the final angular relationship of said arms is established, and separate spring means for actuating said toggle arms and moving said valve stem toward closing position when said arms have been moved into angular relationship by said first named spring means, said last named means being inoperative to move said toggle arms and valve stem while said armature is held by said electromagnet and adapted when rendered operative to exert a force on said toggle arms and valve stem which is materially greater than the electromagnetic force normally holding said armature.

8. In a device of the character described, in combination with a gas valve having a valve stem, an electromagnet having an armature operatively connected to the valve stem and adapted to hold said valve open, a sleeve slidably mounted on the valve stem, a toggle mechanism operatively connecting said armature with said sleeve and valve stem, means between said valve stem and sleeve providing for limited relative movement therebetween, resilient means between said stem and sleeve for moving said stem and sleeve relatively within the limits permitted by said last named means, resilient means for moving said stem and sleeve as a unit after said limit has been reached, both of said resilient means being rendered inoperative by the positioning of said toggle arms when said armature is held by said electromagnet, and means for rendering both said resilent means operative when said electromagnet is deenergized.

9. In a device of the character described, in combination with a gas valve having a valve stem, an electromagnet having an armature operatively connected to the valve stem and adapted to hold said valve open, a sleeve slidably mounted on the valve stem, a toggle mechanism operatively connecting said armature with said sleeve and valve stem, means between said valve stem and sleeve providing for limited relative movement therebetween, resilient means between said stem and sleeve for moving said stem and sleeve relatively within the limits permitted by said last named means, resilient means for moving said stem and sleeve as a unit after said limit has been reached, both of said resilient means being rendered inoperative when said toggle arms are aligned to position said armature for restraint by said electromagnet, and resilient means for moving said toggle arms out of alignment when said electromagnet is deenergized to initiate the operation of both said resilient means.

10. In a device of the character described, in combination with a gas valve having a valve stem, an electromagnet having an armature op-

eratively connected to the valve stem and adapted to hold said valve open, a sleeve slidably mounted on the valve stem, a toggle mechanism operatively connecting said armature with said sleeve and valve stem, means between said valve stem and sleeve providing for limited relative movement therebetween, resilient means between said stem and sleeve for moving said stem and sleeve relatively within the limits permitted by said last named means, resilient means for moving said stem and sleeve as a unit after said limit has been reached, both of said resilient means being rendered inoperative when said toggle arms are aligned to position said armature for restraint by said electromagnet but when operative exerting a force on said toggle arms and valve stem which is materially greater than the electromagnetic force for restraining said armature, and resilient means for moving said toggle arms out of alignment and rendering both said resilient means operative, said last named resilient means exerting a force which is materially less than said electromagnetic force.

11. In a device of the character described, in combination with a gas valve having a valve stem, said valve having a casing wall containing an aperture through which said valve stem extends, an electromagnet having an armature both disposed exteriorly of said casing wall whereby neither said armature nor said electromagnet is subjected to the gas controlled by said valve, means disposed exteriorly of said casing wall for operatively connecting said armature and valve stem, and means for initiating the movement of said last named means when said electromagnet is deenergized and becoming inoperative before movement of said connecting means is completed, and separate means for thereafter completing the movement of said connecting means to move said valve to closed position.

12. In a device of the character described, in combination with a gas valve having a valve stem, said valve having a casing wall containing an aperture through which said valve stem extends, an electromagnet having an armature both disposed exteriorly of said casing wall whereby neither said armature nor said electromagnet is subjected to the gas controlled by said valve, toggle mechanism operatively connecting said valve stem and said armature, resilient means for actuating said toggle mechanism and moving said valve to closed position when said electromagnet is deenergized and said armature is released, and means effective only for initiating the operation of the toggle mechanism for bringing said last named means into operation when said armature is released by said electromagnet.

13. In a device of the character described, in combination with a gas valve having a casing, a valve member and a valve stem extending to the exterior of said casing, an electromagnet having an armature operatively connected to the valve stem and adapted to hold said valve open, means intermediate the valve member and the wall of the valve casing constituting a valve to prevent leakage of gas along the valve stem, a sleeve slidably mounted on the valve stem, a toggle mechanism operatively connecting said armature with said sleeve and valve stem, resilient means cooperating with said sleeve and yieldable upon engagement of said means between the valve member and casing wall to hold said last named means in contact under resilient tension, and separate resilient means for actuating said toggle mechanism and moving said valve member to closed position.

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