June 6, 1933. H. A. ATWATER 1,913,149

VARIABLE GAS FLOW ORIFICE

Filed June 22, 1931

Fig. 1.

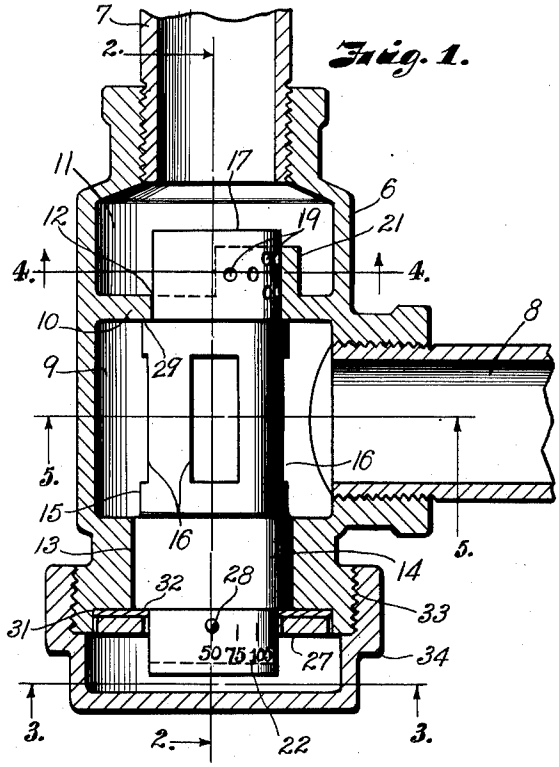


Fig. 2.

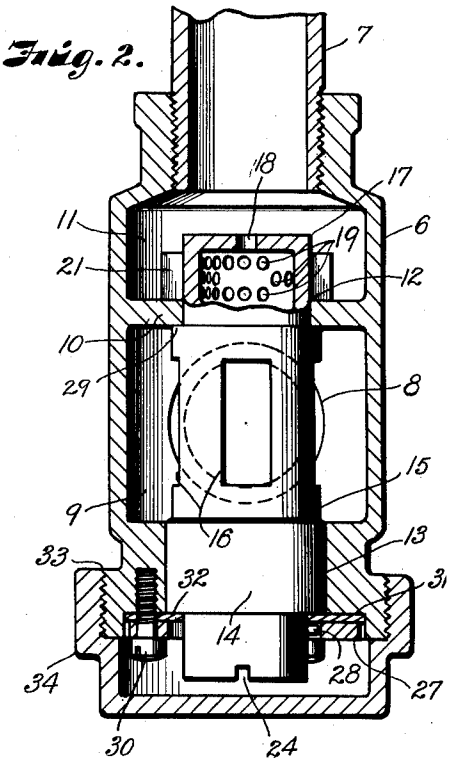


Fig. 3.

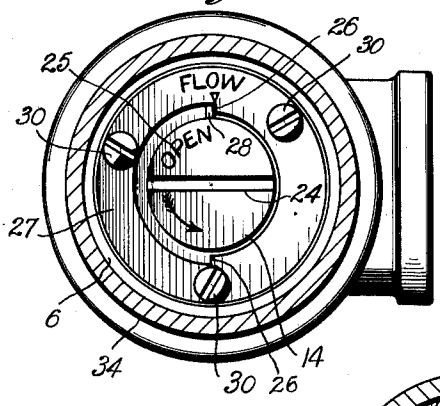


Fig. 4.

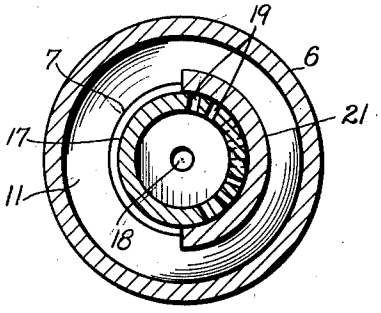
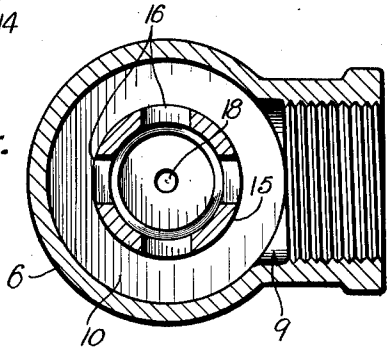


Fig. 5.



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UNITED STATES PATENT OFFICE

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VARIABLE GAS FLOW ORIFICE

Application filed June 22, 1931. Serial No. 545,899.

The present invention relates to gas flow regulating devices and the primary object of the invention is to provide a practical and efficient valve structure for gas burning equipments which require a set and fixed rate of flow of the gaseous fuel, together with provision for an accurate and positive regulation of the gas flow in accordance with the requirements of a given installation.

For this purpose I have devised a novel and improved valve construction having provision for a fixed minimum rate of flow of the gaseous fuel, and also an adjustable orifice structure whereby the rate of gas flow may be varied within proper limits, and effecting such variation by fixed positive steps corresponding to given measured increments in the flow, for which the device may be permanently set and secured for operation at the chosen rate for which the installation is best adapted.

It is also sought to provide a construction of this character which is not only convenient but substantially foolproof, as well as flexible in its design to permit interchange of the adjustable orifice unit, and adapted to meet all the essential requirements of equipment of this class.

With the foregoing general objects in view, as well as various minor details of improvement, the invention will now be described by reference to the accompanying drawing, illustrating a practical embodiment of the proposed valve design, after which those features and combinations deemed to be novel will be set forth and claimed.

In the drawing—

Figure 1 is a longitudinal sectional view of a valve construction constructed in accordance with the present invention; and

Figures 2, 3, 4 and 5 are sectional detail views, representing sections taken on the lines 2—2, 3—3, 4—4 and 5—5, respectively, of Figure 1.

In all gas burning equipment, using either natural or artificial gas fuel, and in both domestic and industrial installations, one indispensable requirement is the adjustment of the flow of air and the gaseous fuel to the end that there will be economy and efficiency in the combustion operation. In some installations there is provision for carrying this adjustment out automatically at all times, including periodic variations in the generation of heat by the burner's operation. Such automatic control, however, calls for relatively expensive equipment and is therefore confined to the minority of installations. In a great number of gas installations the regulation of the burner's operation is carried out either by manual control or through the automatic regulation of a thermostat. Since in most cases the manual controlling device is designed to be regulated by a householder who is unfamiliar with the basic principles of combustion, such manual control installations make it imperative that there be practical provision for maintaining a maximum limit for the gas flow to the burner.

In thermostatically controlled equipment the operation is in most cases on the "off or on" principle or method of firing, and in such burner operations it is quite essential that a definite and constant flow of the gas should be maintained.

For such definite, fixed gaseous flow, the most obvious as well as simplest method available is by the opening and setting of a gas cock or valve to a given position, according to the rate of gas flow to be maintained, but this has the disadvantage of not providing an indication of the rate of flow (in cubic feet per hour), and moreover is not of a foolproof character inasmuch as the setting of the valve may either be accidentally or intentionally changed, thereby disturbing the adjustment and proper operation of the burner. Another method of setting or fixing the gas flow is by the use of orifice plates, provided with a fixed set of orifices, interposed in the path of the gas flow. While this practically eliminates the possibility of change by the householder, its most serious disadvantage is the lack of means of adjustment should occasion for same arise, which is somtimes the case before proper service results are obtained; this difficulty arises in operations where an organization has the supervision of a large number of installations which are being serviced and maintained, and for which the fixed orifice device is too cumbersome

and inflexible to be of any practical value.

For such operations therefore a variable gas flow device, which may be readily and quickly set, adjusted and readjusted when necessary, is a practical necessity for giving a definite rate of gas flow, in addition to which it is desirable that the design be such as to make it proof against being tampered with by unauthorized persons.

Certain designs having this purpose have found more or less general application, one having an orifice structure which is adjustable by operation on the expanding clutch-jaw principle, and another having an orifice like the shutter-operated opening of a camera lens. In devices of this character, the principle of the adjustment for varying the size of the orifice is that of a steady and continuous rate of change in the area of the orifice opening as contrasted with any rate of change which is non-continuous or intermittent with certain intervals of no change or variation between the successive adjustments. Hence, in the continuous rate of change design, there can be no calibration of the various rates of flow except by location of the markings at intervals coinciding with certain exact areas of the orifice openings; as a matter of fact, various devices of the type referred to which are in use are not even so marked, thus making it necessary to estimate roughly the proper setting or adjustment of the orifice, and then checking the adjustment by timing the rate of gas flow at the meter. This method of experimental adjustment is likely to involve considerable loss of time, particularly in the case of installations which do not have separate gas meters, where the problem presented is one of real difficulty. Again, even with a variable flow regulating device of the most practical design and with proper markings, it is quite obvious that no two persons would ever be able to secure exactly the same setting or valve adjustment, and when it is considered that unskilled labor is relied upon for making these installations it follows that settings or adjustments by two such different workmen will often produce rates of flow of a widely different character.

From this discussion it will be apparent that the only practical solution for the difficulties involved is to make provision for an adjustment of the gas flow in which the regulation will effect a variation by distinct steps or measured intervals in the rate of flow, and in a way which will make due allowance for the inevitable variations in manual settings or adjustments by different persons. Since the usual method of installing a variable orifice unit locates it in the gas supply line intermediate the burner and a pressure regulator which maintains a fixed constant pressure, the service requirements for such installations present no difficulty to the adoption of the step system of variable flow control; for the fixed gas pressure is reduced only by the frictional pressure drop through the variable orifice, burner and intermediate piping, and with a given type of burner and piping arrangement it becomes possible to calibrate the variable orifice unit quite exactly, in accordance with definite rates of flow, and mark the unit accordingly. These calibrations can be made as large or small as desired, thereby eliminating any necessity for recourse to a continuous-change type of orifice structure.

Referring now to the drawing in detail, the improved variable orifice structure is illustrated as comprising a valve body or casing 6, the outlet end of which is tapped for the pipe 7 leading to the combustion unit, and one side correspondingly tapped for the gas inlet pipe 8 leading from the pressure regulator (not shown) and communicating with the intake chamber 9 of the casing 6, as shown in Figures 1, 2 and 5. The casing 6 is formed with an internal web or partition 10 separating the chamber 9 from a discharge chamber 11 leading into the outlet pipe 7, and this web and the opposite end of the casing are formed with smooth finished openings 12, 13, respectively, providing bearings for journaling a core member 14 having a hollow barrel portion 15 formed with openings 16 communicating with the intake chamber 9 (Figure 5).

That portion of the core which projects into the discharge chamber 11 is formed as a hollow cylindrical valve extension 17 having an axial and continuously open port or orifice 18 representing the minimum rate of gas flow below which said flow cannot be reduced. The cylindrical body of this valve extension is provided with a plurality of ports or orifices 19 arranged in several circumferential series designed, on rotative movement of the core member, to be successively opened or closed by means of a semicircular flanged bearing extension 21 formed on the web 10 around its core opening 12. The arrangement of the openings and flange, as illustrated in Figure 2, is such that rotation of the core will successively open (or close) either a single or a plurality of the ports or orifices 19, and the opposite or outer end of the core member is appropriately marked with calibrations, as at 22 (see Figure 1), for indicating the setting of the valve structure or the rates of flow corresponding to the number of uncovered openings 18.

As a convenience in rotating the core member, its outer end is provided with a diametrical slot 24 adapted for engagement by a screw driver or similar tool, and with markings, as at 25, indicating the direction of opening movement of the valve structure, which movement is a half turn between stop shoulders 26 provided inside a clamping ring 27 and engaged by a pin 28 carried by the

core member. The ring 27 is held in place by screws 30, and engages a suitably graphited asbestos ring 31, overlapping the outer margin of the opening 13 as well as a shoulder 32 formed on the adjacent portion of the core member, thus acting as a gasket effecting a gas-tight seal of the joint around the core; the composition of the ring renders it proof against being affected by temperature, and its lubricated character protects it against damage by rotation of the core without first loosening the several screws 30. The clamping action of the ring 27 and screws 30 serves to hold the shouldered end 29 of the barrel 15 against the margin of the opening 12 in the web or partition 10 (Figures 1 and 2).

Preferably the ring is marked with the word "Flow" and an arrow-point as shown in Figure 3, opposite the upper shoulder 26, overlying the flow scale 22.

The outer end of the casing 6 is provided with an external thread 33 for receiving an end cover cap 34 which serves as a means of sealing the outer end of the core member and adjacent parts and, if preferred, any desired form of locking or sealing device may be employed for securing the end cover in place and preventing unauthorized persons from obtaining access to the orifice adjusting means.

It is thus apparent that an efficient variable flow construction is provided in which the central or axial opening 18 provides a minimum rate of flow of the gaseous fuel to the combustion unit, which flow rate may not be reduced, and the remaining openings 19 provide means for a "step" rate of flow change or variation; these openings 19 may be drilled to any size, pattern or arrangement for producing any desired variation of the flow rate in a step or noncontinuous manner, which will enable the orifice structure to be adjusted to an exact setting by different persons while insuring the exact flow corresponding to any given adjustment or rate of flow as permitted by the uncovered holes. That is to say, a person rotating and setting the core for any given rate of flow, as indicated by the scale 22, will be assured of the marked flow corresponding to that adjustment, unless the setting should be so far off on either side of the indicated marking as to begin to cover or uncover the next following set of openings 19. The improved design is such as to facilitate this proper calibration of the end of the core member to indicate the successive rates of flow comprising the adjusting range of the device, which is a marked advantage over any variable orifice structure having no rate or scale markings of any kind.

In addition, the provision of the central opening 18, corresponding to the minimum rate of flow, which is always fixed or unvariable in the present construction, is a further advantage, and comprises a feature very difficult to obtain in the so-called "clutch-jaw" type of variable orifice structure. Moreover, the maximum rate of flow may be secured in my improved device by simply providing the proper number of orifice openings 19, without any change in the core member itself, whereas in other designs this maximum rate of flow is made to depend upon the size of the orifice elements and therefore requires a change in these to produce any variation of this maximum flow.

A further outstanding advantage in the improved construction is the adaptability of the same for the interchange of core members, as these may be carefully machined so as to provide a plurality of different core units for use with the same valve body or casing. This renders the improved design most flexible, for by stamping the end of the core member with the proper scale indicating the flow limits and the size and type of burner unit for which the same has been calibrated, it is possible for the most unskilled laborer to install the proper core element for any burner size and adjust the same for any desired conditions of flow. This obviously eliminates any experiment or checks on the gas meter for insuring the proper orifice adjustment and control.

It will therefore be apparent that I have devised a most practical and efficient construction for answering all the requirements of a variable flow orifice construction and performing the necessary functions in a most convenient and expeditious manner, and while I have illustrated and described what is now deemed to constitute the most practical and preferred form of construction I desire to be understood as reserving the right to make whatever changes or modifications may fairly fall within the scope of the appended claims.

Having described my invention what I claim to be new and desire to secure by Letters Patent is:

1. A variable orifice structure for gaseous fuel regulation comprising a casing provided with inlet and outlet connections and formed with an internal flange, and a movable core member provided with an axial constantly-open minimum flow orifice and also with a plurality of variable flow orifices normally closed by said flange and adapted to be successively uncovered by adjustment of said core member.

2. A variable orifice structure for gaseous fuel regulation comprising a casing having separate intake and discharge chambers, and an adjustable hollow core member having an axial outlet orifice maintained constantly opened to said discharge chamber and a set of lateral openings in communication with the intake chamber and also a plurality of variable flow orifices communicable with the discharge chamber, and closure means adapt-

ed, on movement of the core member, to successively open or close said variable flow orifices.

3. A variable orifice structure for gaseous fuel regulation comprising a casing provided with an internal web separating its interior into intake and discharge chambers, an adjustable hollow core member having openings in communication with the intake chamber and a plurality of variable flow orifices communicable with the discharge chamber, and a closure flange carried by said web in position to successively open or close said orifices in response to adjusting movements of the core member.

4. A variable orifice structure for gaseous fuel regulation comprising a casing provided with inlet and outlet connections, a rotatable core having an axial outlet opening in constant communication with said outlet connection and receiving openings communicating with the inlet connection and also a plurality of variable flow orifices adapted, upon rotation of said core member, to be successively closed or opened into communication with the outlet connection, and a combination clamping and packing ring structure forming a seal between the casing and outer end of the core and providing stop shoulders for limiting the rotative adjusting movements of the core in opposite directions.

5. A variable orifice structure for gaseous fuel regulation comprising a casing provided with an internal web separating its interior into intake and discharge chambers, an adjustable hollow core member having an axial outlet orifice in constant communication with said discharge chamber and also lateral openings in communication with the intake chamber as well as a plurality of variable flow orifices communicable with the discharge chamber, and a closure flange carried by said web in position to successively open or close said variable flow orifices in response to adjusting movements of the core member.

6. A variable orifice structure for gaseous fuel regulation comprising a casing provided with an internal web separating its interior into intake and discharge chambers, an adjustable hollow core member having one end thereof journaled in said web and formed with an axial outlet opening in constant communication with the discharge chamber and a plurality of variable flow orifices also communicable with said discharge chamber, the body portion of said core member having intake openings communicating with said intake chamber and also formed with a shoulder abutting said web, a closure flange carried by said web for opening or closing said orifices in response to adjusting movements of the core member, and clamping means cooperating with the other end of said core member for maintaining its shoulder in abutting relation to said web and securing the core member in any selected position of adjustment.

7. A valve core for variable orifice structures, comprising a hollow substantially cylindrical member formed with lateral intake openings and an axial outlet opening at one end of said member, and also provided with a plurality of lateral orifices arranged in a circumferential series adjacent to said end containing the axial outlet opening.

In witness whereof I hereunto affix my signature.

HARRY A. ATWATER.