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[54] DEVICE FOR CONTROLLING A MIXTURE OF TWO GASES

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[58] **Field of Search** .... 48/180 P; 137/88, 90, 553, 137/604; 259/4; 417/183, 184, 191, 198

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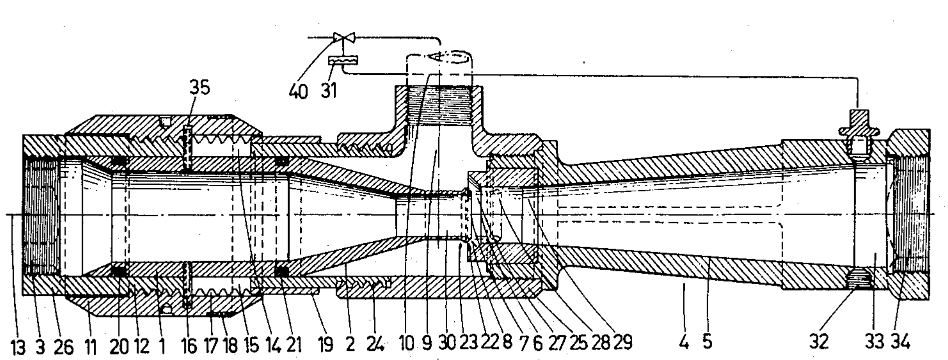
[57] **ABSTRACT**

A device for controlling a mixture of two gases comprises two nozzles mounted in the extension of one another and movable one with reference to the other, a ring, provided with an internal screw thread, being mounted in movable manner on a stationary sleeve enclosing one of the nozzles, the other one being mounted so as to be able to slide inside the said sleeve, at least one slot being provided in the sleeve, one driving member for the second nozzle, cooperating with such slot, being secured to the wall of the said nozzle and entering freely in the ring, so as to permit the said nozzle to move inside the device by making the ring rotate around its axis with reference to said sleeve.

7 Claims, 3 Drawing Figures



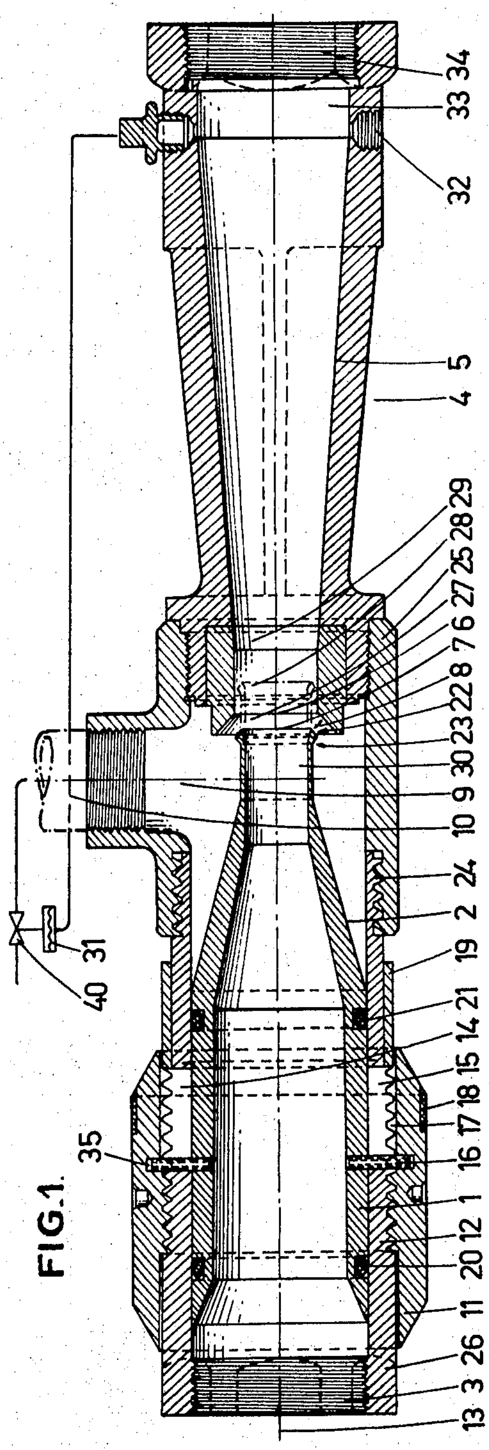


FIG.1.

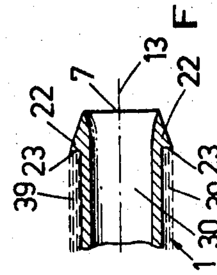


FIG.2.

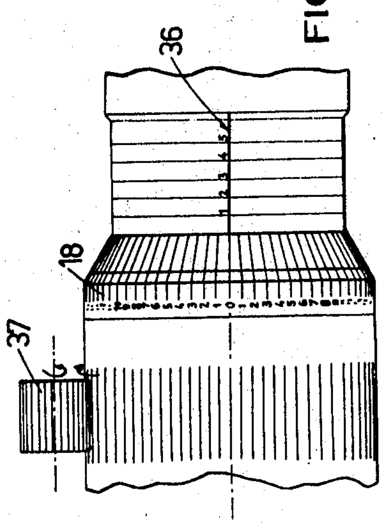


FIG.3.

DEVICE FOR CONTROLLING A MIXTURE OF TWO GASES

The present invention relates to a device for controlling a mixture of two gases, such as a comburent gas and a combustible gas, comprising a first nozzle with a converging portion, such nozzle communicating with a first adduction pipe for one of the said components of the mixture and in the rear of which is a second nozzle coaxial with the first one, the second nozzle having a diverging portion, at least the entry of the latter being of larger internal circular cross-section than the external circular cross-section of the first nozzle, a chamber wherein opens a second adduction pipe for the other component of the said mixture, enclosing the outlet end of the first nozzle and communicating with the entry of the second nozzle, means being provided to vary along the common axis of the two nozzles, the relative position of the latter.

The aim of the invention is to provide an improved device of the said type enabling to achieve a strictly constant ratio, upstream of the equipment to be supplied, such as heating apparatus, between the two components of the mixture and this for flows of this gas mixture varying between fairly large limits.

For this purpose, in the device according to the invention, the means provided to vary, along the common axis of the two nozzles, the relative position of the latter comprise at least one ring, provided with an internal screw thread, mounted in movable manner on a stationary sleeve enclosing one of the nozzles, the nozzle located inside the sleeve being fitted in such a manner as to be able to slide inside the latter along the axis thereof; at least one slot, parallel to the said axis, passing right through the portion of the wall of the said sleeve covered by the said ring; a driving member for such nozzle co-operating with such slot and being secured to the inner wall of the nozzle and engaging freely the inner face of the ring covering the slot, so as to permit the said nozzle to move inside the device by making the ring rotate around its axis with reference to the sleeve.

Advantageously, the sleeve comprises at least two slots diametrically opposite one another, parallel to the axis of the nozzle fitted inside the sleeve, the said driving member for such nozzle co-operating with each one of the said slots.

According to a preferred embodiment of the invention, the first nozzle is assembled in the said sleeve, the second nozzle being stationary with reference to the latter.

According to a particular embodiment of the invention, a flange is provided at the outlet of at least one of the nozzles, so as to permit establishing close to such outlet, a stationary gas film.

Particular construction embodiments of the present invention will now be described by way of non limitative examples, with reference to the accompanying drawings in which:

FIG. 1 shows diagrammatically a longitudinal cross-section partially broken away, of a particular embodiment of the invention.

FIG. 2 shows on a large scale a detail of the device shown in FIG. 1.

FIG. 3 is an elevational view, partially broken away, of a detail of a modified form of the device shown in FIG. 1.

The device according to the invention, comprises a first nozzle **1**, with a converging portion **2** and communicating with an adduction pipe **3** for a first gas, and a second nozzle **4** coaxial with the first one and mounted downstream of the latter.

The second nozzle **4** has a diverging portion, at least the entry **6** of the latter being of larger internal circular cross-section than the external circular cross-section of the outlet **7** of the first nozzle **1**, so as to permit engaging such outlet **7** in the entry **6** while maintaining in between them an annular space **8** for the passage of a gas originating from a chamber **9** enclosing the outlet end of the first nozzle **1** and communicating with the entry **6** of the second nozzle **4**. A second adduction pipe **10** for a second gas opens into the said chamber **9**.

A ring **11** with an internal helical thread **17** is freely threaded on a stationary sleeve **12** enclosing the nozzle **1**, the latter being fitted in such a manner as to be able to translate inside the sleeve along the common axis **13**.

Two slots **14** and **15**, diametrically opposite, parallel to the said axis, pass right through the portion of the wall of the said sleeve covered by the thread **17** of the ring **11**. A driving member, provided by a stem **16**, co-operates with each one of these slots **14** and **15**. This member is secured by one of its ends to the outside wall of the nozzle and engages freely with its other end an annular slot **35** provided in the inner face of the ring **11** and concentric with the latter, these two stems **16** being also diametrically opposite one another.

The movement of such nozzle **1** along its axis **13** is thus achieved by making the ring **11** rotate around its axis **13** with reference to the stationary sleeve **12**.

The ring **11** is knurled on its outside face and provided with a graduation **18** showing the ratio of the two gases in terms of the position of this ring of the sleeve **12**.

As the position of the nozzle **1**, for a given value of the ratio of the two gases, is a function of the density of the latter, a secondary ring **19** is provided on the sleeve **12**, partially beneath ring **11** and which carries on its outside face, parallel to its axis, a graduated scale **36**. Ring **11** may be rotated around its axis in both directions. The graduation of the scale **36** in such that for one revolution of the ring **11**, the latter moves in the axial direction by one unit of the graduation, so that the rim of the ring **11** located on the side of the ring **19** shall coincide with the line mark according to the graduation **36**. The two graduated rings **11** and **19** thus determine a vernier permitting measurement, in a very accurate manner, of the axial movement of the nozzle **1** and, consequently, also the ratio of the two gases.

The ring **19** may, just like the ring **11**, rotate around its axis so as to enable a movement of the graduated scale **36** simultaneously with the graduations **18** and thus ensure the accessibility of the reading of the scale, independently of the location of the device.

Furthermore, in order to allow for the types of gases used, the ring **19** is able to slide, with reference to ring **11**, on the sleeve **12** in the longitudinal direction of the latter. This longitudinal motion must be such that, in the case of using a combustible gas and a comburent gas, a composition of gas mixture is obtained which is the neutral combustion or the theoretical basis composition when the line "**0**" of the graduation **18** of the ring **11** is positioned facing the axial line of scale **36**. By chemical calibration of the stoichiometrical ratio of the combustible gas — comburent gas mixture, the line "0" of the graduation **18** will thus be established facing the line "0" of the scale **36** on the ring **19** in such a manner as to obtain on one side of the line "0" of the ring **11** the graduations corresponding to the reducing ratios and on the other side of such line "0" the graduations corresponding to the oxidising ratios.

Between the nozzle **1** and the sleeve **12** is provided an annular gasket **20** on either side of the slots **14** and **15.**

These gaskets **20** are arrested in an annular housing **21** provided in the outer wall of the nozzle **1.**

The outlet **7** of the nozzle **1** is provided with an outer circular flange **22,** shown on a larger scale in FIG. **2,** which establishes a stationary gas film **39** on the outer wall of such nozzle **1,** located in the space **8** during the flow of the gas originating from the pipe **10** to the second nozzle **4.** The wall **23** of such flange **22,** provided to establish the said stationary gas film on the outer wall of the nozzle, forms with such wall an angle equal to 90° at the most. The sleeve **12** is provided, at the end thereof directed towards the chamber **9,** with an outer screw thread **24,** by means of which it is screwed on a hollow body **25** determining such chamber **9.**

The nozzle **4** which is stationary, is screwed in the said hollow body on the side facing that one in which is screwed the sleeve **12.**

The entry **6** of the nozzle **4** is converging and is formed by two conical frustums **27** and **28** placed end to end. The taper of the first frustum **27** substantially exceeds that of the other frustum **28,** which is of rather low taper. The conical frustrum **28** is connected to the said diverging portion **5** by means of a cylindrical portion **29** providing a narrowing in the nozzle **4.**

The converging portion **2** of the nozzle **1** is extended by a cylindrical portion **30** as far as the outlet of the said nozzle, this cylindrical portion being coaxial with the nozzle **4** so as to achieve a laminar flow of the gas at the outlet of the nozzle **1.** On the other hand, a pressure regulator **31** connected to a pipe **32** branched off the outlet **33** of the nozzle **4** at the entry of a mixing chamber **34** and controlling a valve **40** mounted in the pipe **10,** assures the maintenance in the chamber **9** of a pressure substantially equal to that present at the outlet **33** of the nozzle **4,** in the mixing chamber **34.**

With the device according to the invention it is possible to obtain a constant ratio of two gases in a mixture of the latter while maintaining a perfect laminar flow of the superposed coaxial layers of these two gases in the device, in particular at the time when the latter are in contact with one another so that no transmission of energy, within the framework of Bernoulli's law, takes place in the device, the mixture of the two gases only taking place in the mixing chamber **34** in which are mounted, for example, two inverted pitch helical screws which have not been shown on the drawings.

Thus for a mixture of combustible and comburent gas, when the device is mounted on a burner, the ratio of the two gases is not influenced by the back-pressure at the burner outlet.

The coefficient of friction on the walls of the annular space **8** supplying the gas originating from the pipe **10** around the jet of the other gas escaping from the nozzle **1,** is maintained as constant as possible independently of the rate of the gas passing therein when the flow varies.

It is, however, well known that as a result of the friction of the gas on the walls, the rate of flow in the thickness of the jet is not uniform but assumes the shape of a parabola which is the more drawn out the more the mean rate of the flow increases. It results, therefrom, consequently, that if precautions are not taken, the flow will not be proportionate to the loss of head in this annular space **8.** Thus, for this reason, the outer circular flange **22** has been provided at the outlet **7** of the first nozzle. The stationary film **39** hereinbefore described, which is then established, substantially reduces the coefficient of the said friction within the annular space **8** on the outer wall of the nozzle **1** because the coefficient of friction between a stationary layer of a fluid and a mobile layer of the same fluid is far less than that for the same fluid on a solid wall.

A similar flange can, of course, be provided on the inner wall of the entry **6** of the nozzle **4.** In the annular space **8** between the nozzles **1** and **4** a substantially plane cross-sectional diagram of the rates will then be obtained the form of which, in practice, does not vary within the usual limits of flow of the device, thus ensuring the ratio of the two gases remaining constant.

On the other hand, another condition met by the device according to the invention and which is also essential in order to reach the aim, hereinbefore defined, is that it permits to carry out with a very great accuracy an axial movement of one of the nozzles, under the circumstances the nozzle **1,** with reference to the other nozzle in order to adjust the ratio of the two gases. This accuracy permits the maintenance, for a relative position of the two nozzles, of a well defined ratio constant in time for such poition.

In certain known types of devices of this kind, the nozzle **1** is slightly inclined during its movement so that its axis no longer coincides with that of the other nozzle **4.** The annular space **8,** therefore, will no longer be in that case centered for such devices and the asymmetry then established will hinder the flow of the gas and influence the said ratio when the flow varies.

It is for this reason that a particularly advantageous embodiment of the device is that in which the drive of the movable nozzle takes place in points symmetrical with reference to the axis, for example in locations diametrically facing one another.

FIG. **3** shows a modified form of the device hereinbefore described and enables carrying out the movement of the mobile nozzle in a continuous manner. This embodiment is particularly of interest in order to maintain a constant chemical composition of the mixture of two gases, when the temperature of one at least of the gases varies. Indeed, the variation of the temperature of a gas results in a variation of its density and, consequently, the number of moles passing through the nozzle **1** under the influence of the difference in pressure at the entry of nozzle **1** with reference to the outlet thereof.

For this purpose, according to the invention, the ring **11** is moved by means of a pneumatic or hydraulic servo-motor, not shown in FIG. **3,** controlled by an analyser of the gas mixture present at the outlet of the nozzle **4,** in the mixing chamber **34,** this analyser not having been shown either in FIG. **3.**

The outer cylindrical surface of the ring **11** is grooved along its generatrices. The servo-motor drives a straight tooth pinion **37** meshing with the grooves of the said cylindrical surface, which thus provide teeth.

In normal operational position, the cylindrical portion **30** of the nozzle **1** engages nozzle **4** as far as the conical frustrum **28** of the latter as shown in dash lines in FIG. **1**. Thus the device does not operate as an injector as, on account of the laminar and parallel flow of the two gases, the doses of which are to be controlled, there is no exchange of energy between such gases, i.e. a drawing of one gas by the other.

It should also be noted that the length of the whole of the device according to the invention, does not vary when the distance between the two nozzles is changed so that its mounting in a supply circuit of an apparatus, for example of a burner, does not present any difficulty.

It is well understood that the invention is not limited to the described embodiment and that many changes may be introduced therein without departing from the scope of the present patent application.

Thus either the nozzle **1** or the nozzle **4** and even, as the case may be, both of them may be mobile; that the device may be used also for controlling a mixture of any two gases such as hydrogen and air, or of air and a combustible gas.

On the other hand, the ring **11** may, in a modified form of the object of the present invention, be freely threaded on the sleeve **12**, the driving members **14** and **15** then engaging the threads of the inner screw thread **24** provided in the ring **11**. In this modified form, the ring **11** therefore does not move along the axis thereof, when it is made to rotate around the latter in order to adjust the position of the nozzle **1** with reference to the nozzle **4**.

I claim:

1. A device for controlling a mixture of two gases, said device comprising:

a first nozzle adapted to communicate with a first adduction pipe at the upstream end thereof and having a converging portion at the downstream end thereof;

a second nozzle coaxial with said first nozzle and having a diverging portion at the upstream end thereof at least the entry of which is of larger internal cross-section than the external cross-section of the downstream portion of said first nozzle, whereby said downstream portion of said first nozzle may be inserted in said entry of said second nozzle;

a housing defining a chamber which is adapted to communicate with a second adduction pipe, said chamber being shaped so as to enclose the downstream end of said first nozzle and so as to communicate with the entry of said second nozzle; and

means for varying the relative position of said first and second nozzles along their common axis, said means comprising:

a stationary sleeve (a) provided with an external screw thread, (b) enclosing one of said nozzles in a manner permitting said one of said nozzles to translate inside said stationary sleeve along the axis thereof, and (c) having at least one slot therein which is parallel to said axis and which passes right through said sleeve;

at least one ring provided with an internal screw thread, by which it is threadedly interconnected with the external screw thread on said stationary sleeve so as to be movable thereon over said slot in said stationary sleeve, said ring being further provided with an annular recess coaxial with said sleeve and located on the inner face of said ring; and

a driving member for said one of said nozzles which cooperates with said slot, is secured to the outer wall of said one of said nozzles, and engages freely said annular recess in said ring, whereby said one of said nozzles can be caused to move axially inside the device by making said ring rotate around its axis.

2. A device as claimed in claim **1** wherein said sleeve has at least two such slots located diametrically opposite one another in said sleeve and a like number of driving members for said one of said nozzles cooperating with said slots.

3. A device as claimed in claim **1** wherein said sleeve has a plurality of such slots symmetrically located in said sleeve and a like number of driving members for said one of said nozzles cooperating with said slots.

4. A device for controlling a mixture of two gases, said device comprising:

a first nozzle adapted to communicate with a first adduction pipe at the upstream end thereof and having a converging portion at the downstream end thereof;

a second nozzle coaxial with said first nozzle and having a diverging portion at the upstream end thereof at least the entry of which is of larger internal cross-section than the external cross-section of the downstream portion of said first nozzle, whereby said downstream portion of said first nozzle may be inserted in said entry of said second nozzle;

a housing defining a chamber which is adapted to communicate with a second adduction pipe, said chamber being shaped so as to enclose the downstream end of said first nozzle and so as to communicate with the entry of said second nozzle; and

means for varying the relative position of said first and second nozzles along their common axis, said means comprising:

a stationary sleeve (a) provided with an external screw thread, (b) enclosing one of said nozzles in a manner permitting said one of said nozzles to translate inside said stationary sleeve along the axis thereof, and (c) having at least one slot therein which is parallel to said axis and which passes right through said sleeve;

a first ring provided with an internal screw thread, by which it is threadedly interconnected with the external screw thread on said stationary sleeve so as to be movable thereon over said slot in said stationary sleeve, said first ring being further provided with a graduation on the visible face thereof showing the ratio of the two gases to be mixed in terms of the position of said first ring on said sleeve, said graduation extending close to one of the rims of said sleeve over at least a portion of the periphery thereof;

a second ring mounted in a movable manner on said stationary sleeve close to said first ring, whereby the location of said second ring may be adjusted with reference to said first ring, said second ring being provided with a mark line extending parallel to the axis of said sleeve on the visible face thereof; and

a driving member for said one of said nozzles which the with said slot, is secured to the outer wall of said one of said nozzles and engages freely the inner face of said first ring,

whereby said one of said nozzles can be caused to move axially inside the device by making said ring rotate around its axis.

5. A device as claimed in claim **4** wherein

the outer diameter of at least the portion of said second ring adjacent to said first ring is less that the inner diameter of at least the portion of said first ring adjacent to said second ring, thereby permitting at least a portion of said first ring to pass over at least a portion of said second ring, and

said mark line on said second ring has in its turn graduations providing a graduated scale, the space between two consecutive graduations of such scale being equal to the pitch of the internal thread of said first ring, whereby the latter moves by one graduation on the second ring when it completes one revolution around its axis.

6. A device for controlling a mixture of two gases, said device comprising:

a first nozzle adapted to communicate with a first adduction pipe at the upstream end thereof and having a converging portion at the downstream end thereof, said first nozzle being further provided with an outer flange around the outlet thereof the upstream wall of which forms an angle with the outside wall of said first nozzle which is less than or equal to 90°, whereby it establishes a stationary gas film extending upstream from said flange over at least a portion of the outside wall of said first nozzle when the device is in use;

a second nozzle coaxial with said first nozzle and having a diverging portion at the upstream end thereof at least the entry of which is of larger internal cross-section than the external cross-section of the downstream portion of said first nozzle, whereby said downstream portion of said first nozzle may be inserted in said entry of said second nozzle;

a housing defining a chamber which is adapted to communicate with a second adduction pipe, said chamber being shaped so as to enclose the downstream end of said nozzle to a degree at least sufficient to include said stationary gas film and so as to communicate with the entry of said second nozzle; and

means for varying the relative position of said first and second nozzles along their common axis, said means comprising:

a stationary sleeve (a) provided with an external screw thread, (b) enclosing one of said nozzles in a manner permitting said one of said nozzles to translate inside said stationary sleeve along the axis thereof, and (c) having at least one slot therein which is parallel to said axis and which passes right through said sleeve;

at least one ring provided with an internal screw thread, by which it is threadedly interconnected with the external screw thread on said stationary sleeve so as to be movable thereon over said slot in said stationary sleeve; and

a driving member for said one of said nozzles which cooperates with said slot, is secured to the outer wall of said one of said nozzles, and engages freely the inner face of said first ring,

whereby said nozzle can be caused to move axially inside the device by making said ring rotate around its axis.

7. A device as claimed in claim **6** wherein said upstream wall of said flange is planar.

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