# United States Patent [19]

**King**

[11] **3,823,743**

[45] ***July 16, 1974**


[54] **PRESSURE REDUCING DEVICE**


[75] Inventor: **Colin Forbes King,** Sutton Coldfield, England

[73] Assignee: **Dunlap Holdings Limited,** London, England



[ * ] Notice: The portion of the term of this patent subsequent to July 18, 1989, has been disclaimed.

[22] Filed: **Oct. 26, 1971**

[21] Appl. No.: **192,146**

[30] **Foreign Application Priority Data**

Nov. 6, 1970 Great Britain .................... 52847/70

[52] **U.S. Cl.** .................................... **138/42,** 181/71

[51] **Int. Cl.** ............................................ **F15d 1/00**

[58] **Field of Search** ............ 138/42, 40; 181/50, 51, 181/69, 70, 71



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 1,229,434 | 6/1917 | Flockhast | 181/71 X |
| 2,180,084 | 11/1939 | Gebauer | 138/42 X |
| 2,512,155 | 6/1950 | Hill | 181/70 |
| 3,061,039 | 10/1962 | Peters | 181/72 |
| 3,374,855 | 3/1968 | Kelly et al. | 181/71 X |
| 3,677,300 | 7/1972 | King | 138/42 |



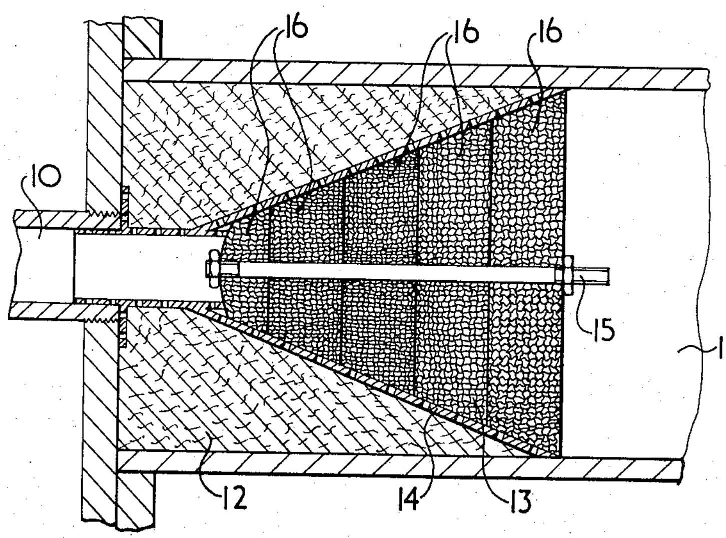
*Primary Examiner*—William I. Price
*Assistant Examiner*—Steven M. Pollard
*Attorney, Agent, or Firm*—Stevens, Davis, Miller & Mosher

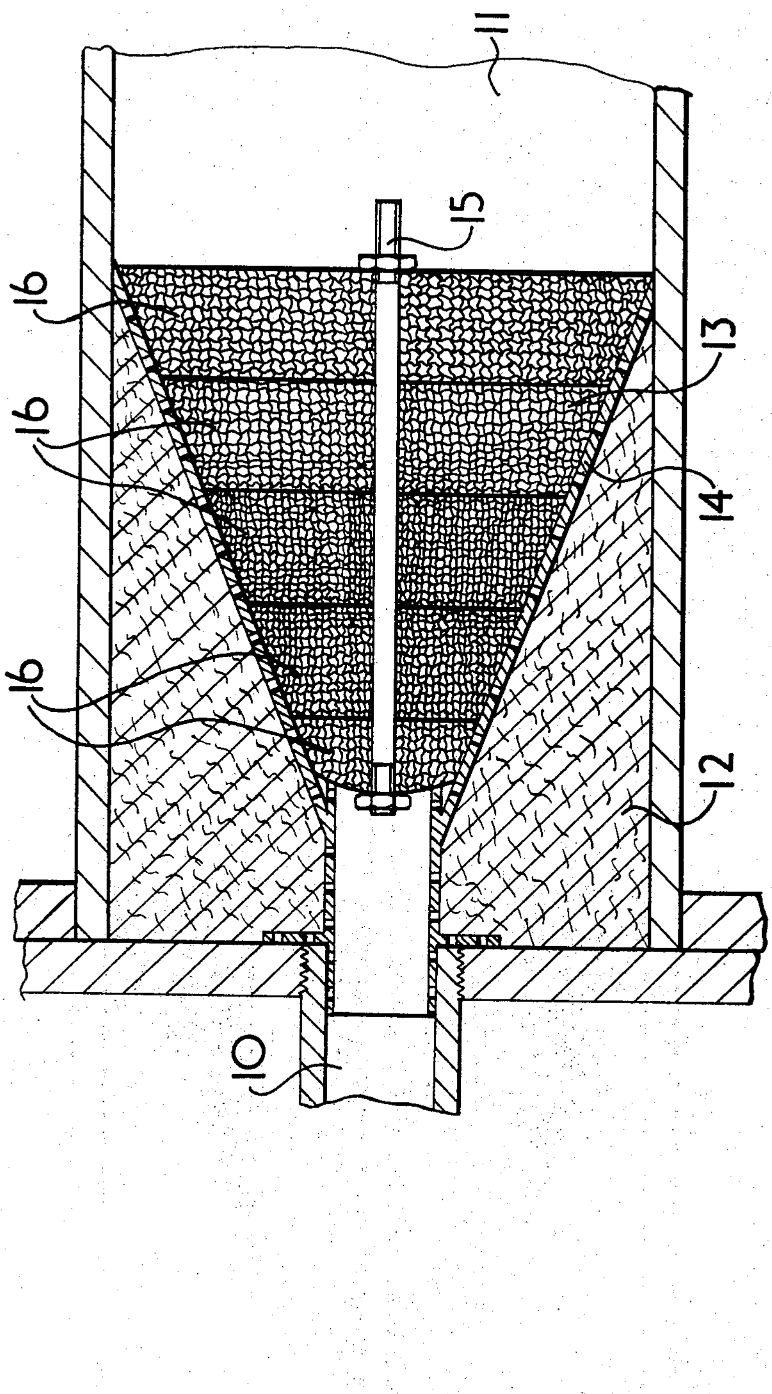


[57] **ABSTRACT**

A pressure reducing device comprises an inlet for high pressure gas, an outlet for low pressure gas and a path therebetween for flow of gas from inlet to outlet, said path including at least one porous baffle having an inner portion made of porous material disposed in an inner zone of said path and an outer portion comprising a fibrous medium disposed in an outer zone of said path, the inner portion having a lower flow resistance than the outer portion. The porous materials used for the inner portion of the baffle include: layers of gauze, expanded metal, sintered metal, ceramic foams and plastics foams such as rigidified foams. The fibrous materials used for the outer portion of the baffle include; spun mineral fibers, natural fibers and glass wool.


**15 Claims, 1 Drawing Figure**




11
15
16
16
16
13
14
12
10

# PRESSURE REDUCING DEVICE

This invention relates to pressure reducing devices.

It is frequently necessary to reduce a high pressure stream of gas to a low pressure stream. Such a requirement often occurs in high pressure distribution of gases where the pressure is required to be reduced before transmission to the point of use. Conventionally, the reduction in pressure is achieved by passing the high pressure gas through a duct having a relatively large cross-sectional area. This procedure tends to create a high level of noise which can present a serious problem, for example where large quantities of gas are depressurised in urban areas.

According to the present invention a pressure reducing device comprises an inlet for high pressure gas, an outlet for low pressure gas and a path therebetween for flow of gas from inlet to outlet, said path including at least one porous baffle having an inner portion made of porous material disposed in an inner zone of said path and an outer portion comprising a fibrous medium in an outer zone of said path, the inner portion having a lower flow resistance than the outer portion.

In a preferred embodiment of the invention the inner and outer portions of the baffle are separated by a perforated sheet material. This material may be metal, plastics, woven fabric or any other suitable material. This layer of perforated sheet is used to keep the fibrous medium in place, in order to assist with its function the baffle may be covered with fine cloth, thereby effectively reducing the size of the apartures without effecting the impedance of the baffles.

In general, the inner portion of the porous baffle should be such as to permit expansion of the gas while reducing to a minimum the turbulence produced by the expansion. It is preferred that this inner portion is either conical or part spherical in shape.

Porous materials that may be used for the inner portion of the porous baffle of the present invention include: layers of gauze, expanded metal, sintered metal, ceremic foams and plastics foams such as rigidified foams. These materials should preferably have porosities which give low flow resistance. The flow resistance of the materials used should normally be less than 1 psi per inch thickness when in a stream of gas moving at a velocity within the range 5 to 80 m/sec.

In particular the inner portion of the porous baffle is made of a three-dimensional network arranged so as to define a plurality of cellular spaces which intercommunicate with one another, said network being made substantially of metal.

The three-dimensional network is preferably produced by spraying, dipping or electrodeposition of the metal on a porous material.

The porous material onto which the metal may be deposited may be in the form of an agglomerate of fiber, such as a felted material or a spong-like or foam material such as natural sponge or a synthetic resinous foam. In general, polyurethane foams are preferred. The porous material may remain in the metal or it may be removed, e.g. by heating to melt or "ash-out" the material.

Where a high degree of porosity is required, the foam may be reticulated foam, i.e., a foam in which the organic phase is a three-dimesnional network with no substantial wall portions defining the cells. Such reticulated foams may be produced by removing the relatively thin cell walls from a foam, e.g., by chemical means such as aqueous, sodium hydroxide in the case of polyurethane foams.

When the metal is to be electrodeposited it is, of course, necessary either to use a porous material which is electrically conducting or to render the material conducting by means of a conducting surface layer. Nonconductive materials may be made self-conducting by means of an additive such as graphite or a powdered metal. A conducting surface layer may be applied by coating the material with a curable resinous material incorporating a conductive additive or by chemically depositing a metal thereon, e.g., by the reduction of ammonical silver nitrate in situ. In general, where chemical deposition is employed the surface should be treated with one or more sensitizing agents such as stannous chloride followed by palladium chloride for silver.

Metals which can be electrodeposited include silver, copper, nickel and iron. Alloy foams can be produced in some cases by direct plating and in other cases two or more metals may be deposited successively and the alloy formed by heating the resultant structure. Steel foams can be produced by the incorporation of the required amounts of carbon and/or nitrogen. The carbon may be derived from organic material forming the basic foam or added to an electroplating bath.

The resulting alloy foams can, of course, be heat-treated to give desirable physical properties, such heat-treatments being well-known in the art.

The fibrous medium used in the outer portion of the porous baffle is preferably relatively dense compared with the inner portion and may be any fibrous material that is usually used for sound absorption. In particular spun mineral fiber i.e., asbestos wool or "Stillite D **50**" (Registered Trade Mark) natural fiber, i.e. cotton wool or glass wool are found useful. These materials are preferably packed so that they have a flow resistance in excess of 50 times and more preferably in excess of 100 times that of the material of the inner portion when measured at the same air velocity.

The baffles according to this invention may be housed in a tube of suitable material positioned between the high pressure inlet and the low pressure outlet, in which case the baffles may be sealed in the tube to prevent gas from by-passing them.

The baffles may be used alone or in conjunction with an additional mechanical reducing valve and/or with other types of baffle.

A preferred embodiment of the invention is hereinafter described with reference to the accompanying drawing which shows a diagrammatic cross-section.

The preferred embodiment shown in FIG. **1** comprises a cylindrical inlet **10** and a coaxial cylindrical outlet **11** having a substantially larger diameter than the inlet **10.**

Disposed between the inlet **10** and the outlet **11** is a porous baffle made up of independent inner and outer portions separated by a sheet of 1/16 inch perforated steel **14** in the form of a cone.

The outer portion **12** of the baffle is packed with spun mineral fiber which is available under the trade name "Stillite D 50." The inner portion **13** is in the form of a male cone of 10 pore per inch foam metal having a flow resistance of 0.5 psi per inch thickness at an air velocity of 40 m/sec and is located in position by the perforated sheet steel cone **14.**

In order to ease construction of the foam metal cone it is constructed from several sheets **16** which are held together by an axial retaining bolt **15.**

A pressure reducing device of the type described above was constructed in which the inlet had an internal diameter of 2.5 cm and the outlet an internal diameter of 12.7 cm. The overall length of the baffle was 15.7 cm and the inner portion was in the form of a 45° cone made of 10 pore/inch foam metal.

The pressure reducing device was tested using spun mineral fiber (Stillite D 50) and Analar grade glass wool in the outer portion of the baffle, these materials were packed so that the outer portion had a flow resistance of 100 psi per inch thickness at an air velocity of 40 m/sec. The results from these tests are compared in Table I with those for expansion of the gas without a silencer and using only the inner portion of the baffle as a silencer.

TABLE I

| Silencer | Air Velocity m/sec | Sound Level dB | Reduction in sound level dB | Impedance of Silencer (lb/in$^2$) |
|---|---|---|---|---|
| None | 15.2 | 117 | — | — |
| | 30.4 | 130 | — | — |
| Foam Metal and Stillite D 50 | 15.2 | 81 | 36 | 2 |
| | 30.4 | 81 | 49 | * |
| Foam Metal and Glass Wool | 15.2 | 82 | 35 | 2 |
| | 30.4 | 82 | 48 | * |
| Foam Metal alone | 15.2 | 94 | 23 | 2 |
| | 30.4 | 94 | 36 | * |

* Back pressure with silencer less than without silencer (i.e. negative impedance).

As can be seen from the results the pressure reducing devices of the present invention give substantial reductions in noise levels over the unsilenced case.

At the higher velocity 30.4 m/sec. with the unsilenced pipe, air passing through the inlet reached the speed of sound. This caused shock waves to be set up downstream of the inlet creating high impedance to flow. This does not take place with the silencer in place so more gas can be forced through allowing a higher flow rate to be reached for a particular low pressure.

Having now described my invention — what I claim is:

**1.** A pressure reducing device comprising an inlet for high pressure gas, an outlet for low pressure gas and a path therebetween for flow of gas from inlet to outlet, said path including at least one porous baffle having an inner portion made of porous material disposed in an inner zone of said path and an outer portion comprising a fibrous medium disposed in an outer zone of said path, the inner portion having a lower flow resistance than the outer portion.

**2.** A pressure reducing device according to claim **1** in which the inner portion comprises a material selected from the group consisting of layers of gauze, expanded metal, sintered metal, ceramic foam and plastic foams.

**3.** A pressure reducing device according to claim **2** in which the inner portion comprises reticular metal foam.

**4.** A pressure reducing device according to claim **3** in which the reticular metal foam comprises metal deposited on a reticulated organic foam.

**5.** A pressure reducing device according to claim **4** in which the reticular metal foam comprises electrodeposited metal on reticulated organic foam.

**6.** A pressure reducing device according to claim **1** in which the porous material comprising the inner portion has a flow resistance of less than **1** psi per inch thickness in a stream of gas moving at a velocity within the range 5 to 80m/sec.

**7.** A pressure reducing device according to claim **1** in which the inner portion is conical.

**8.** A pressure reducing device according to claim **1** in which the inner portion is part spherical.

**9.** A pressure reducing device according to claim **1** in which the fibrous medium in the outer portion is selected from the group consisting of spun mineral fiber, natural fiber and glass fiber.

**10.** A pressure reducing device according to claim **9** in which the material of the outer portion has a flow resistance in excess of 50 times that of the inner portion when measured at the same air velocity.

**11.** A pressure reducing device according to claim **9** in which the material of the outer portion has a flow resistance in excess of 100 times that of the inner portion when measured at the same air velocity.

**12.** A pressure reducing device according to claim **1** in which the inner and outer portions are separated by a perforated sheet baffle.

**13.** A pressure reducing device according to claim **12** in which the perforated sheet baffle comprises a material selected from the group consisting of metal, plastic material and woven fabric.

**14.** A pressure reducing device according to claim **12** in which the perforated sheet baffle is covered with fine cloth.

**15.** A gas pressure reducing device, comprising:

an inlet for high pressure gas;

an outlet for low pressure gas, the area of said outlet being larger than the area of said inlet;

a porous baffle between said inlet and said outlet, said baffle comprising

an inner portion of porous material whose cross-sectional area increases progressively along an axis in the direction from said inlet to said outlet;

an outer portion comprising a fibrous medium radially surrounding said inner portion; said inner portion having a lower gas flow resistance than said outer portion.

* * * * *

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3823743 Dated July 16, 1974

Inventor(s) Colin Forbes KING

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the title page, the name of the assignee should read --Dunlop Holdings Limited--.

Signed and sealed this 19th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
★ U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3823743 Dated July 16, 1974

Inventor(s) Colin Forbes KING

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the title page, the name of the assignee should read --Dunlop Holdings Limited--.

Signed and sealed this 19th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
☆ U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.