

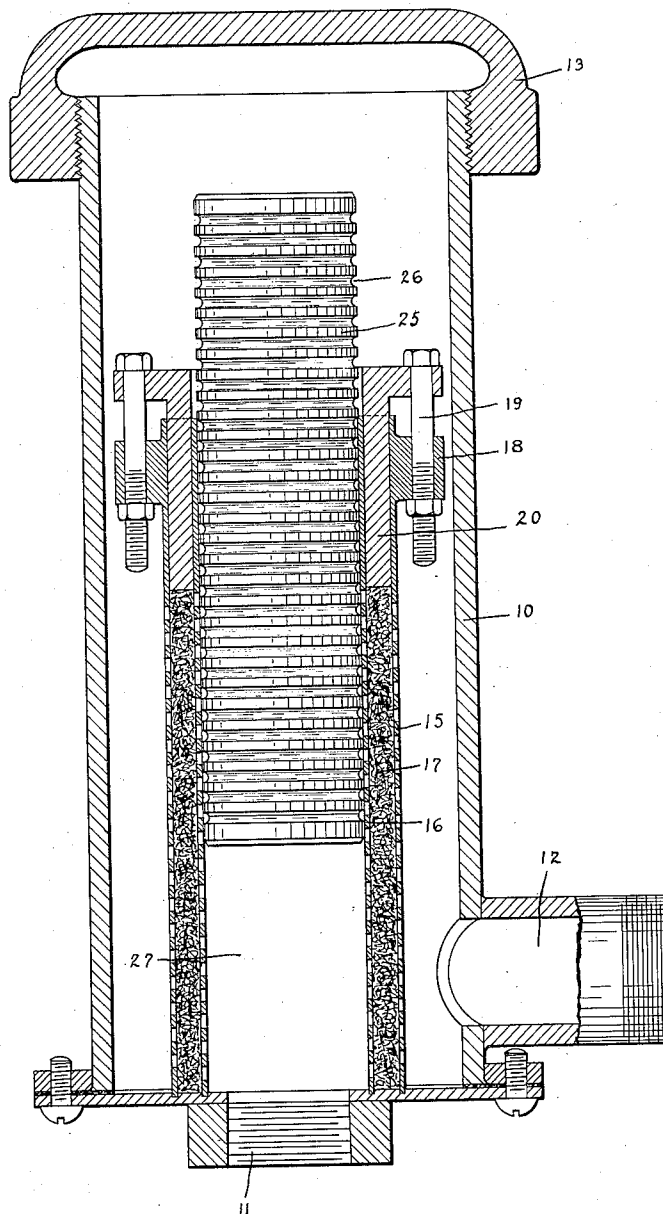
Aug. 4, 1925.

1,548,288

H. F. SMITH

GAS PURIFICATION

Original Filed Dec. 19, 1921



Witnesses
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Patented Aug. 4, 1925.

1,548,288

UNITED STATES PATENT OFFICE

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GAS PURIFICATION.

Application filed December 19, 1921, Serial No. 523,392. Renewed June 8, 1925.

To all whom it may concern:

Be it known that I, HARRY F. SMITH, a citizen of the United States of America, residing at Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Gas Purification, of which the following is a full, clear, and exact description.

This invention relates to purification of gas, and particularly to the treatment of producer gas to remove impurities such as tar and the like therefrom.

In the patents issued to Harry F. Smith Numbers 1,099,773 and 1,140,198, bearing dates respectively of June 9, 1914 and May 18, 1915, is set out a method of purifying gas and a type of apparatus for carrying that method into effect. The method of purification therein set out is based on the fact that if a gas containing impurities therein, such impurities for example as tar, is passed through a diaphragm of spun glass, or some analogous substance, at a suitable velocity, a coalescence or agglomeration of the particles of impurity will take place with the production of particles of such substantial size that they will readily separate out under the action of gravity, when carried out of the diaphragm by the current of gas. Experience seems to show that the cleaning effectiveness of such apparatus is in accordance with the velocity of flow of the gas through the diaphragm. The greater the velocity of flow the better the cleaning. And in order to secure sufficiently satisfactory cleaning under actual operating conditions, it is apparently necessary to at all times maintain a minimum velocity of flow. The velocity of flow of the gas within the diaphragm, other conditions remaining constant, is dependent upon the differential pressure upon opposite sides of the diaphragm, and the cleaning effectiveness is, in practice, maintained by so controlling the cleaning apparatus that the drop in pressure across the diaphragm shall not, normally, fall below a predetermined minimum. In practice it has been found that a differential pressure of substantially two pounds gives very effective cleaning, not less than 99.5 per cent of the tar being removed from the gas under these circumstances. Preferably a pressure of substantially two pounds on one side and four pounds on the other side of the diaphragm is maintained, though

these pressures may vary so long as the drop in pressure across the diaphragm does not depart materially from the desired differential of two pounds, or whatever differential is found to give the desired cleaning effectiveness.

In the patent issued to Harry F. Smith May 24, 1921 No. 1,379,056 is illustrated and described one method, and apparatus, for effecting the desired cleaning of gas.

One of the principal objects of the present invention is to provide another method in connection with this form of purification, by means of which the desired cleaning effectiveness may be maintained.

Another object of the invention is to provide suitable apparatus for carrying that method into effect.

Other objects and advantages of the invention will be apparent from the description set out below when taken in connection with the accompanying drawing, in which is illustrated in section, a form of purifying apparatus embodying this invention.

In the form of apparatus shown the numeral 10 designates a drum or housing, having an inlet opening 11, adapted for connection to a main through which the fluid to be cleaned passes from any suitable source into the housing 10. An outlet 12, adapted for receiving the delivery main, through which the gas is led to any desired place of use or storage, is also provided through which the gas which has been treated passes out from the housing. The upper part of the housing is closed by means of a removable cap 13, the construction being such that access to the interior of the housing may be readily had upon removal of the cap. The lower part of the housing is also preferably made detachable, though it may be made integral if desired. Suitable packing material may be interposed between this lower closure and the housing, in order to prevent leakage.

Positioned within the housing is a cylindrical sleeve 15, preferably of perforated sheet metal, a second cylindrical sleeve, 16 also, preferably, of perforated sheet metal, being positioned within the sleeve 15, the two sleeves being so proportioned that a suitable space is provided which is adapted to receive spun glass, or other suitable filamentous material, which serves as a pervious, non-filtering, diaphragm. The sleeve

15 is provided at its upper end with outstanding lugs 18 having threaded passages therein adapted to receive the adjusting bolts 19, which cooperate with the closure and compression member 20, positioned within the space between the two sleeves 15 and 16, and, preferably, in substantially gas tight connection with these two sleeves, so that there may be no leakage of gas upwardly between these members. This member 20 not only serves to thus prevent the escape of gas from between the two sleeves 15 and 16, but also for the primary purpose of compressing the filamentous material 17 to the desired density.

Slidably mounted within the inside of the inner sleeve 16 is a piston 25, which is in substantially gas tight contact with the cooperating surface of the sleeve 16, and which is in addition, provided with grooves 26, throughout its length, which serve to prevent the passage of untreated gas from the space 27, within the inside of the diaphragm, upwardly between the piston 25 and the sleeve 16.

As set out above, when impurities, such as tar and the like, are to be removed from a fluid, such as producer gas the impurity laden gas is passed through a non-filtering pervious diaphragm composed of material such as finely spun glass, hair, or the like, at a suitable velocity, and as the gas passes through the pad or diaphragm the very finely divided tar fog therein will be so acted upon as to cause the extremely minute tar particles to agglomerate into drops of substantial size, which are carried on out of the diaphragm by the flowing gas and are subsequently separated out through gravity. If the quantity of gas passing through the cleaning apparatus were substantially constant, under all conditions, the problem would be comparatively small, for the diaphragm having been arranged at a density to give the desired differential pressure on opposite sides thereof, no further manipulation of the diaphragm would be necessary, but in actual practice the gas is subject to minor pressure fluctuations without any material variation in the quantity of gas passing through the cleaning apparatus, perhaps as a result of temporary clogging of a part of the diaphragm, or for other reasons; and in addition the gas is from time to time subject to wide variations in the quantity passing through the diaphragm, which will in turn be translated into variations in the differential pressure upon opposite sides of the diaphragm unless means is taken to maintain the differential pressure substantially constant.

In the use of the described apparatus for removing tar from producer gas, for example, the space between the sleeves 15 and 16 is filled with the desired filamentous mate-

rial, spun glass say, and the member 20 is then adjusted to give that compression of the filamentous diaphragm which is desirable under the normal operating conditions to be met. When the gas is introduced through the inlet 11 into the space 27 under suitable pressure the piston 25 will move upwardly to uncover a portion of the diaphragm, the upward movement of the piston continuing until the pressure within the space 27 is such as to balance the weight of the piston. If the pressure within the space 27 varies as a result of minor fluctuations during operating conditions, or as a result of a material change of the quantity of gas being used, or as a result of partial clogging of the pad, or for any other reason, the piston 25 will assume a new position corresponding to the changed pressure to maintain that pressure substantially constant. As a result a substantially constant differential pressure, upon opposite sides of the diaphragm, will be secured, and the cleaning effectiveness of the apparatus thus maintained.

Inasmuch as the differential pressure upon opposite sides of the diaphragm is due to the resistance to flow through the diaphragm, and that is controlled by the effective cross sectional area of the opening through the diaphragm, which is in turn dependent, under any given compression of the diaphragm, upon the effective, or uncovered, area of the diaphragm, the piston 25 as it moves up or down functions to control the effective area of the diaphragm and thus to control the differential pressure on opposite sides thereof, by varying the total effective area of the passages through the diaphragm, that is the effective opening through the diaphragm. The term effective opening through the diaphragm, therefore, is used to designate the total cross sectional area, the total opening, through that part of the diaphragm which is not covered by the piston and which part is, therefore, effective in the cleaning operation.

While the method herein described, and the form of apparatus for carrying this method into effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and form of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. The method of purifying gas which consists in passing the gas through a filamentous diaphragm, and varying the effective area of said diaphragm to keep substantially constant the differential pressure on opposite sides thereof.

2. The method of purifying gas which

consists in passing the gas through a filamentous, non-filtering diaphragm; and varying the effective area of said diaphragm to keep substantially constant the differential pressure on opposite sides thereof.

3. The method of purifying gas which consists in passing the gas through a filamentous diaphragm; and automatically varying the effective area of said diaphragm to keep substantially constant the differential pressure on opposite sides thereof.

4. In a gas purifying system a filamentous, non-filtering, diaphragm; and means associated with said diaphragm for varying the effective area thereof to control the cleaning effectiveness.

5. In a gas purifying system, a filamentous diaphragm; and means associated with said diaphragm for automatically varying the effective area thereof to control the cleaning effectiveness.

6. In a gas purifying system, a housing having a cylindrical non-filtering pervious diaphragm therein, said housing having an inlet opening into the space inside the diaphragm and an outlet opening from the space outside the diaphragm; and a slidable piston within the diaphragm, the construction being such that the effective area of the diaphragm is determined by the positioning of said piston.

7. In a gas purifying system, a housing having a cylindrical non-filtering, filamentous diaphragm therein, said housing having an inlet opening into the space within the diaphragm and an outlet opening from the space outside the diaphragm; and a slidable piston within the diaphragm, the construction being such that the effective area

of the diaphragm is determined by the positioning of said piston.

8. In a gas purifying system, a housing having inlet and outlet openings; spaced perforated walls surrounding said inlet opening, filamentous material between said spaced walls, means for compressing said material to give a desired density thereof; and a piston in slidable, and substantially gas tight, contact within the inner of said spaced walls, the construction being such that the piston will rise or fall with fluctuations in the pressure existing within the space inside the perforated walls, to increase or decrease the effective area of filamentous material to maintain substantially uniform the differential pressure on opposite sides thereof.

9. In a gas purifying system, a housing, having inlet and outlet openings; spaced perforated walls surrounding said inlet opening, filamentous non-filtering material between said spaced walls, means for compressing said material to give a desired density thereof; and a piston in slidable, and substantially gas tight, contact within the inner of said spaced walls, the construction being such that the piston will rise or fall with fluctuations in the pressure existing within the space inside the perforated walls, to increase or decrease the effective area of filamentous material to maintain substantially uniform the cleaning effectiveness.

In testimony whereof I hereto affix my signature.

HARRY F. SMITH.

Witnesses:

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L. G. THOMASSEN.