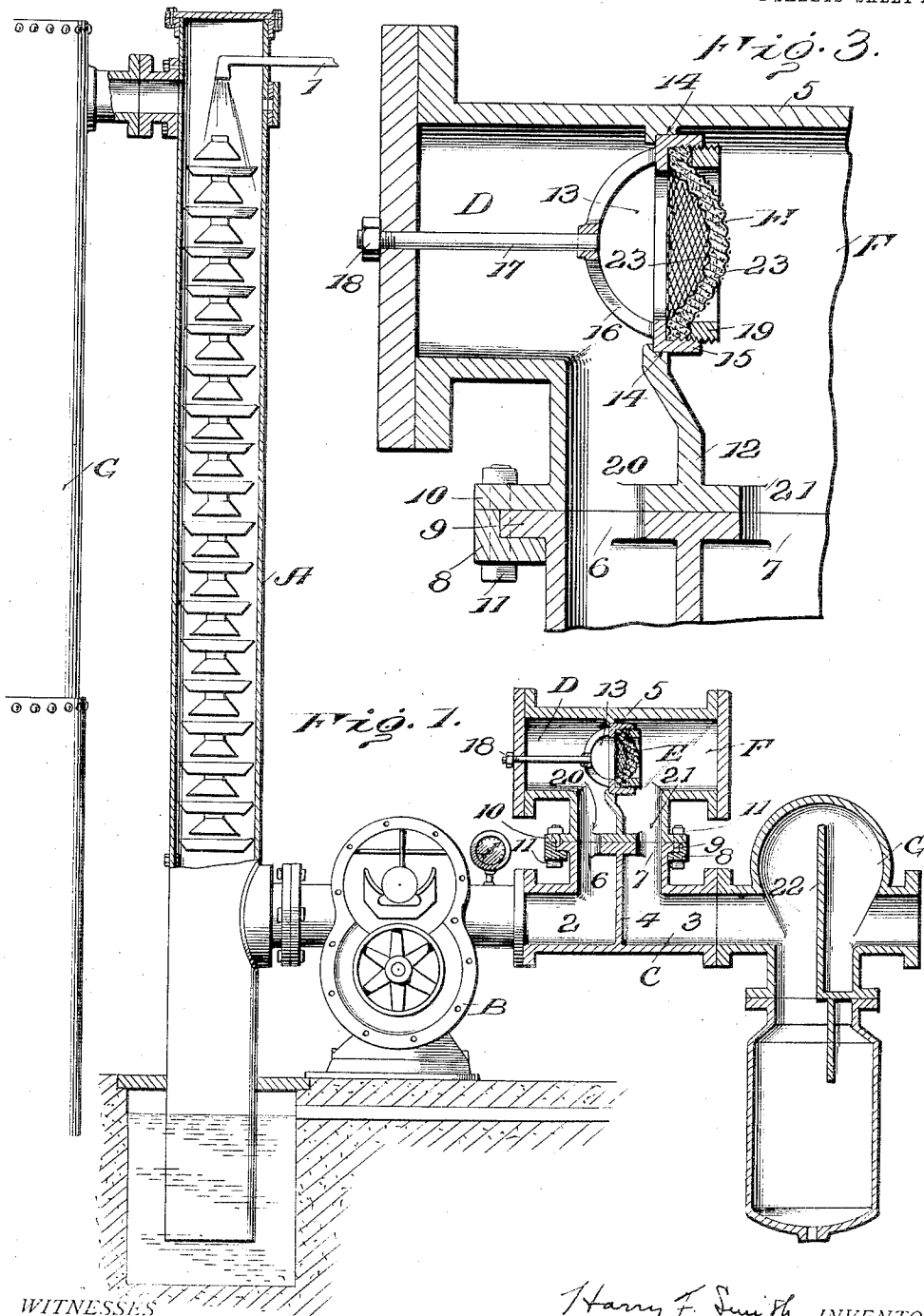


H. F. SMITH.
 APPARATUS FOR PURIFYING GAS.
 APPLICATION FILED OCT. 12, 1912.

1,099,773.

Patented June 9, 1914.

2 SHEETS—SHEET 1.



WITNESSES
 W. A. Williams
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 by Louis Baggett Co
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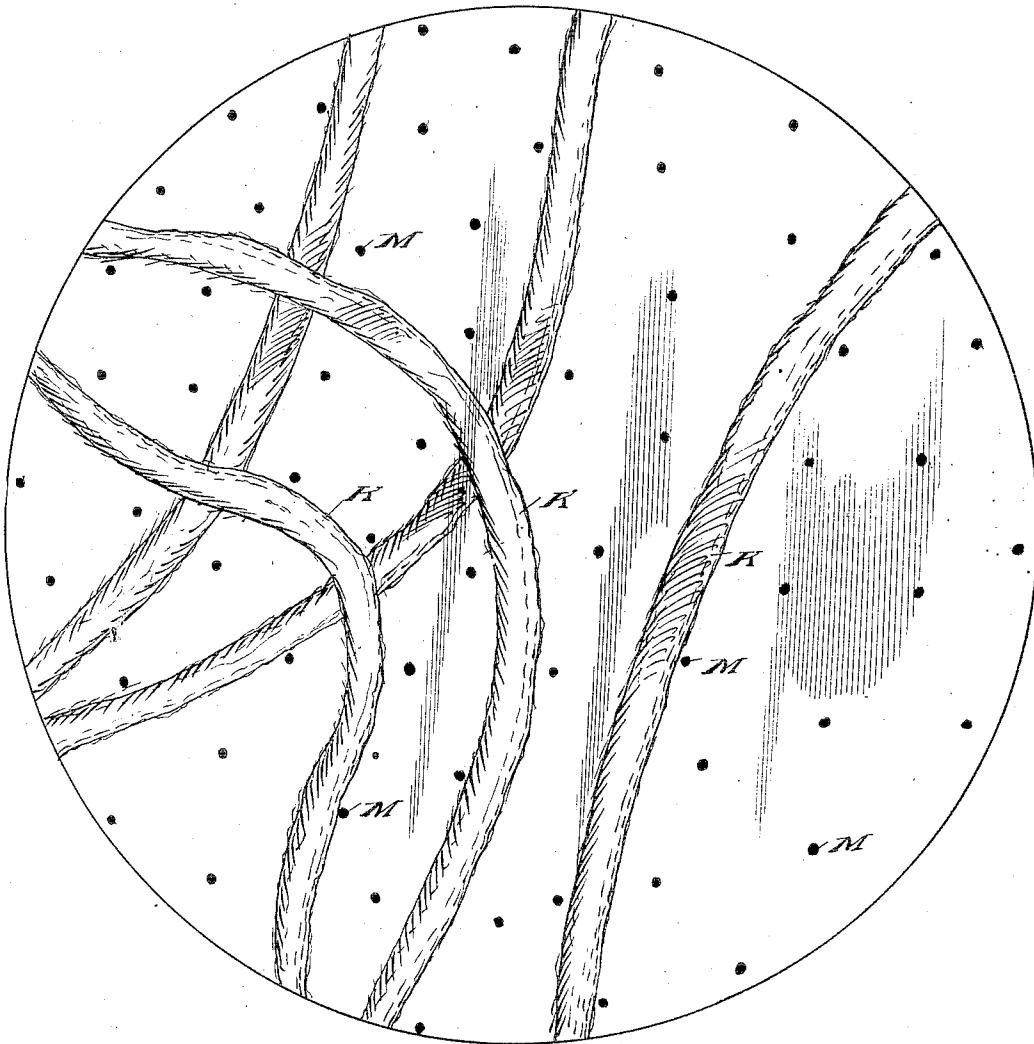
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Fig. 2.



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UNITED STATES PATENT OFFICE.

HARRY FORD SMITH, OF LEXINGTON, OHIO.

APPARATUS FOR PURIFYING GAS.

1,099,773.

Specification of Letters Patent.

Patented June 9, 1914.

Application filed October 12, 1912. Serial No. 725,443.

To all whom it may concern:

Be it known that I, HARRY F. SMITH, a citizen of the United States, residing at Lexington, in the county of Richland and State of Ohio, have invented certain new and useful Improvements in Apparatus for Purifying Gas, of which the following is a specification.

My invention relates to an improvement in apparatuses for purifying gas, and the object is to provide means for causing the gas to be cleaned of the tar particles and other impurities by passing the gas through a porous diaphragm at a velocity sufficient to cause the tar particles to coalesce when brought in contact with the porous or pervious diaphragm and the velocity of the gas will carry the coalesced particles through the said pervious diaphragm, and when the particles have passed through the diaphragm they will fall from the gas by their own weight.

The invention consists of certain novel features of construction and combinations of parts which will be hereinafter more fully described and pointed out in the claims.

In the accompanying drawings—Figure 1 is a view of the apparatus showing some of the parts in section and others in elevation; Fig. 2 is a view showing one plane of the pervious diaphragm greatly magnified. Fig. 3 is an enlarged detail vertical sectional view showing the manner of connecting the casing and cage, and the manner of mounting the diaphragm in the cage.

A gas producer G has a scrubber or cooling chamber A connected thereto, through which cooling chamber the gas passes and during the passage of the gas through the scrubber it is subjected to a spray of water from the pipe 1 for the purpose of cooling the gas. The scrubber or cooler A is connected to a gas pump B, which may be of any approved form. Connected to the pump is a casing C which is provided with chambers 2 and 3 and which chambers are divided or separated from each other by a partition 4. The chamber 2 is provided with an outlet port 6, and the chamber 3 is provided with an inlet port 7. Mounted upon the casing C is a cage 5. A ring 8 extends beneath an annular flange 9 of the casing C and the ring 8 is connected to a flange 10 of the cage 5 by means of bolts

11 for fastening the cage to the casing and permits of the cage rotating upon the casing.

The cage 5 is provided with chambers D and F which are separated by a partition 12. The partition 12 is provided with an opening or orifice 13, and around the wall of the orifice is a recess 14 in which an annular frame 15 is mounted and to which frame a yoke 16 is connected. A rod 17 is connected to the yoke and passes through an end of the cage 5 and a nut 18 is screwed upon the protruding end of the rod 17 for fastening the annular flange in the recess of the partition. A pervious or filamentous diaphragm E is mounted in the annular frame thereby filling the orifice or opening 13 in the partition. The diaphragm is held in the annular frame by a collar 19 which has screw threaded engagement with the annular frame 15.

The chamber D of the cage 5 is provided with a port 20 which registers with the port 6 of the casing C, and the chamber F is provided with a port 21 which registers with the port 7 of the chamber 3 of the casing C. The chamber 3 of the casing C has a separator G connected thereto which is provided with a baffle 22 which is located between the inlet and outlet of the separator.

The diaphragm E can be made of various materials, such as stiff elastic fibers, as hair, sheep's wool, spun glass, and the like, all of which are of a filamentous character. In Fig. 2 of the drawing I have shown one plane of the diaphragm consisting of the filaments K, which are preferably glass wool. This drawing or figure is highly magnified to show the opening between the filaments. A plurality of layers of filaments are matted together so that the filamentous material is generally three-eighths of an inch in thickness. In some instances it may be advisable to make the diaphragm of a greater or less diameter, it depending somewhat upon the conditions under which the apparatus is working. A diaphragm constructed of spun glass is generally able to withstand the pressure of the gas which passes through it, but to relieve undue pressure upon the diaphragm or filamentous material, I place on each side of the filamentous material a fairly coarse wire screen 23, 23. In this way the filamentous material is supported at

many points so that its shape is not changed by the pressures that are brought to bear upon it.

In Fig. 2 the tar particles are represented at M. From this will be seen the relative size of the material constituting the porous diaphragm and of the tar particles that are to be removed from the gas and of the spaces between the solid fibers as they lie in the pervious diaphragm. The openings between the fibers are so large that filtering action in the ordinary sense cannot occur. In other words, it is easily possible for the tar particles to float through these openings without becoming enmeshed in the fibers constituting the diaphragm. This drawing is magnified approximately six hundred diameters or three hundred and sixty thousand times that of the actual materials. The object of the pervious diaphragm, which constitutes the active element of this apparatus in purifying gas, is not to remove the tar from the gas, but to bring about such a combination and agglomeration of the extremely small tar particles that they will then be too large to be carried forward by the gas current and will be dropped out and separated from the gas very readily by gravitation. This pervious diaphragm does not act after the manner of a filter. The function and object of a filter is to entrap the impurities and to retain the impurities upon the structure of the filter. Furthermore, with a filter it is necessary to have the medium carrying the impurities travel slowly through the filter so that the materials that are to be separated will be given ample opportunity to become entrapped in the fiber of the filter. If the medium to be filtered contained tar particles such as are contained in gas, the fibers of the filter would become so coated that it would be impossible to pass anything through the filter. Now, with this invention the gas must be delivered through the diaphragm at a pressure to produce a sufficiently high velocity to cause the tar particles to come in contact with the fibers of the pervious diaphragm and form a fluid film on the fibers and between the fibers thereby bringing the particles together causing a coalescence and by the coalescence of the small particles they become larger, and the larger particles are driven through the diaphragm by the pressure of the gas and are deposited or dropped from the gas because they are heavier than the gas. The diaphragm has a sectional area of about one square inch for each four hundred cubic feet per hour of gas which it is desired to clean. The area of the diaphragm must be small enough so that when the gas is flowing through, a difference in pressure of from one to five pounds shall be maintained across the diaphragm. The gas is much more completely purified when pass-

ing through under a difference of pressure of five pounds than when passing through with a difference of pressure of one pound. The gas in passing through the filamentous material creates a friction which causes a precipitation and collision of the tar particles upon the filamentous material. The tar particles being of a sticky character, form a fluid film upon the filamentous material and between the fibers thereof. The coalescence of the small tar particles on the diaphragm forming larger particles, forms a means of removing the tar particles from the gas as the large particles will be carried through the diaphragm by the gas, and as they have become heavier than the gas they will fall from the gas by gravity.

The cooling chamber A is for the purpose of cooling the gas so that the tar particles are condensed. A portion of the tar vapor is condensed directly on the surface of the cooling chamber, but a part is condensed throughout the volume of the gas in the form of a fine mist or tar fog. It is not essential that the gas should be entirely cold, since good results can be obtained when the gas is fed to the apparatus at temperatures that are considerably above the ordinary atmospheric temperature. After it has been cooled, the gas is pumped to the diaphragm, thereby delivering the gas through the diaphragm at the pressure desired for obtaining the best cleaning action of the gas to be cleaned. Now, the velocity of the gas which passes through the diaphragm causing a friction for creating an attraction of the tar particles and a precipitation and collision of the tar particles upon the fibers of the diaphragm, would not perform its full function if the dimensions of the obstructing material or fibers were large with respect to the dimensions of the tar particles. To illustrate, it has often been proposed to project small streams of gas against baffles, diaphragms and the like, whereby a sudden change in the direction of flow of gas is produced and the tar particles thereby caused to collide violently with the baffles and to be precipitated thereby. Action of this character is imperfect for the reason that an obstruction of any considerable dimensions would carry ahead of it a cushion of compressed gas which would tend to prevent an actual collision between the approaching tar particles and the surface of the baffle. Many of the tar particles would be shielded off and gradually turned aside by the action of the gas cushion. Now, with this diaphragm of the present invention, the dimensions of the opposing bodies are so small that no shielding action is exerted and the tar particles which move forward at high velocity are thrown into direct collision with the fine threads and fibers of the porous

diaphragm. The greater the velocity with which these collisions occur, the greater will be the effectiveness of the action, and further the filamentous material or fibers against which the tar particles are projected should be of very small dimensions so that there is no possibility of the shielding effect being given to the tar particles when they come in contact with the filamentous material. If the action of the porous diaphragm was the same as the ordinary filter, the diaphragm would become clogged with the accumulated material and would soon become inoperative. It is characteristic of a filter that for its effective and successful operation the currents passing through the filter should travel at slow rates so as to give ample opportunity for the materials that are to be separated to become entrapped in the fibers of the filter. Now, with this particular invention, the porous diaphragm does not act as a filter, as it has been found that when the gas passes through the diaphragm E at a slow rate, practically no separation of the tar particles from the gas takes place. The separation is only effected when the gas to be cleaned is forced through the porous diaphragm at high velocities such as would be produced by the application of considerable pressure to the face side of the diaphragm.

The object in having the cage 5 rotatably mounted on the casing C is to reverse the position of the diaphragm. It has been found in practice that coarse impurities carried by the gas will lodge against the face of the diaphragm and will remain there instead of being carried on through with the tar. In other words, the pervious diaphragm will act as a filter for all coarse material and this material will eventually accumulate to such an extent that it will materially hamper the effectiveness of the diaphragm. By reversing the flow of the gas through the diaphragm, that is, by causing the port 21 of the chamber F of the cage 5 to register with the port 6 of the chamber 2 of the casing C and the port 20 to register with the port 7, the gas will pass through the face of the diaphragm which has heretofore been the discharge face or discharge side of the diaphragm, and the coarse impurities or particles will be removed, since they will come on the discharge side of the diaphragm and will be carried off from the diaphragm by the flow of the gas and tar. These coarse impurities will generally come in contact with the tar and as the tar is heavier than the gas the tar will fall from the gas and carry the impurities with it. If, however, these impurities should not be carried with the tar, they will come in contact with the baffle 22 of the separator G, which baffle will prevent any impurities or tar particles from passing from the separator

with the gas. When the cage is rotated a quarter revolution, the openings or ports 20 and 21 will not be in registry with ports 6 and 7, thereby shutting off the flow of gas to the cage. Access can now be had to the diaphragm upon the removal of an end of the cage, and upon the removal of the collar 19 from the frame 15, the diaphragm in the frame can be removed and a new diaphragm substituted.

I claim—

1. In an apparatus for purifying gas, the combination with a rotatable cage provided with gas inlet and outlet openings, of a pervious diaphragm mounted in the cage between the inlet and outlet openings, so that the gas must pass through the diaphragm, said diaphragm adapted to have its position reversed upon the rotation of the cage.

2. In an apparatus for purifying gas, the combination with a casing, of a cage rotatably mounted upon the casing, said casing and cage having communication therebetween for the admission of gas to, and discharge from, said cage, and a pervious diaphragm mounted in the cage through which the gas passes, said diaphragm adapted to have its position reversed upon the rotation of the cage.

3. In an apparatus for purifying gas, the combination with a cage having gas inlet and outlet openings, of a frame removably mounted in the cage between said openings, means for fastening the frame in the cage, a diaphragm mounted upon the frame, and means removably connected to the frame for fastening the diaphragm to the frame.

4. The combination with a casing in communication with the gas supply, of a cage movably mounted upon the casing having openings therein in communication with openings of the casing for the admission of gas from the casing to the cage and discharge of the gas from the cage to the casing, a pervious diaphragm mounted in the cage between the inlet and outlet openings, through which the gas is adapted to pass for separating the tar particles therefrom, and means for fastening the cage to the casing, said cage adapted to be moved so that the openings therein are moved out of registry with the openings in the casing for cutting off the gas supply.

5. In an apparatus for purifying gas, the combination with a casing, of a cage mounted upon the casing, and in communication therewith for the admission of gas from the casing to the cage, a diaphragm mounted in the cage, through which the gas passes for the purpose of removing the tar particles from the gas, said cage adapted to be moved for the purpose of cutting off the supply of gas to the cage.

6. In an apparatus for purifying gas, the combination with a gas producer and cool-

ing chamber, the cooling chamber adapted to receive the gas from the producer and in which cooling chamber the tar vapor is condensed into small particles, of a housing, 5 a pervious diaphragm mounted in the housing, and means for delivering the gas from the cooling chamber under pressure to the diaphragm where the tar particles are caused to be precipitated upon the pervious 10 diaphragm during the passage of the gas through the diaphragm and caused to coa-

lesce thereupon, the coalesced particles of tar adapted to be carried through the pervious diaphragm by the gas when the particles will fall and be separated from the gas by 15 gravity.

In testimony whereof I affix my signature, in the presence of two witnesses.

HARRY FORD SMITH.

Witnesses:

WM. H. EARHART,
ANNA R. EARHART.