No. 856,731. PATENTED JUNE 11, 1907.

G. SAALER.

GAS WASHER.

APPLICATION FILED DEC. 27, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

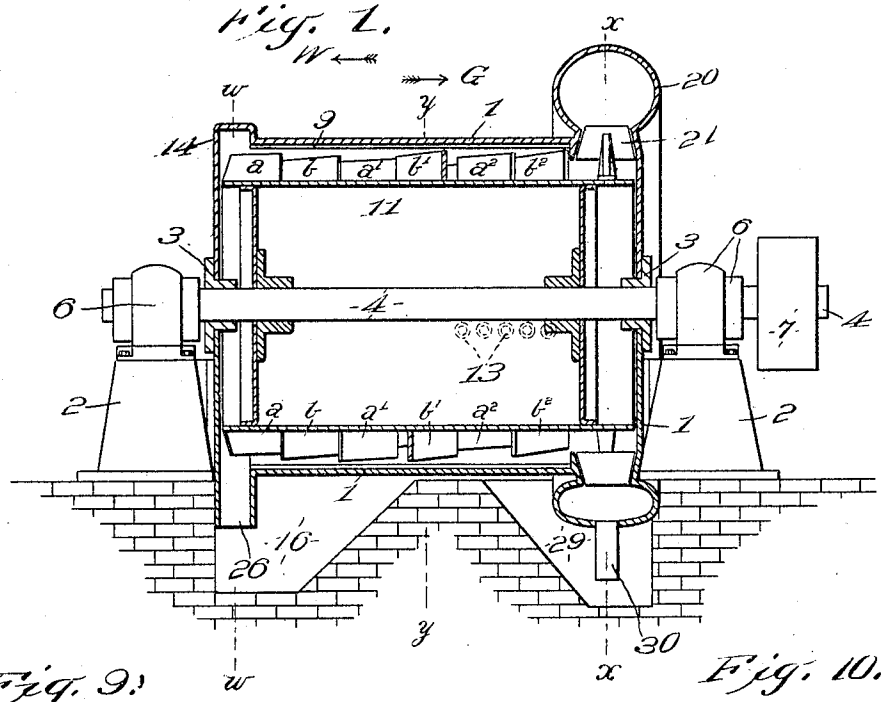


Fig. 9.

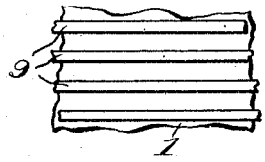


Fig. 2.

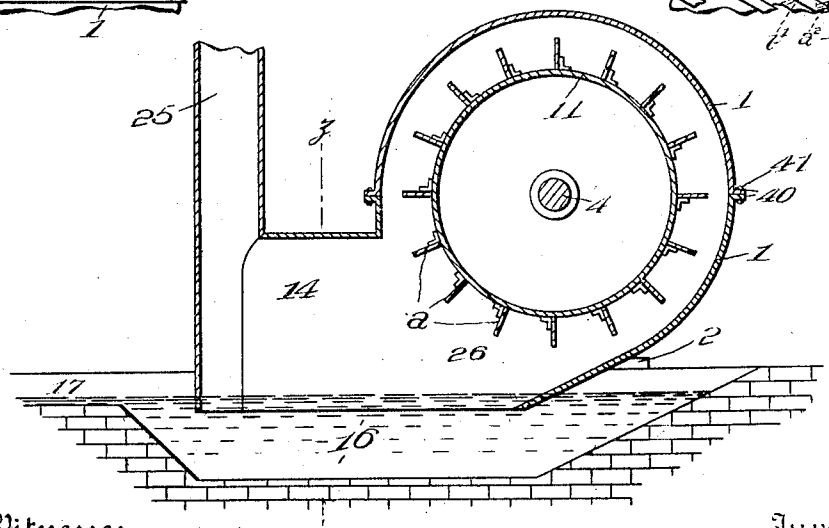
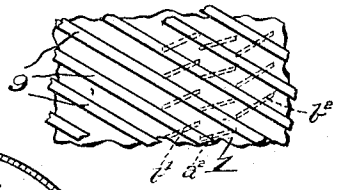


Fig. 10.



Witnesses

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2 SHEETS—SHEET 2.

Fig. 3.

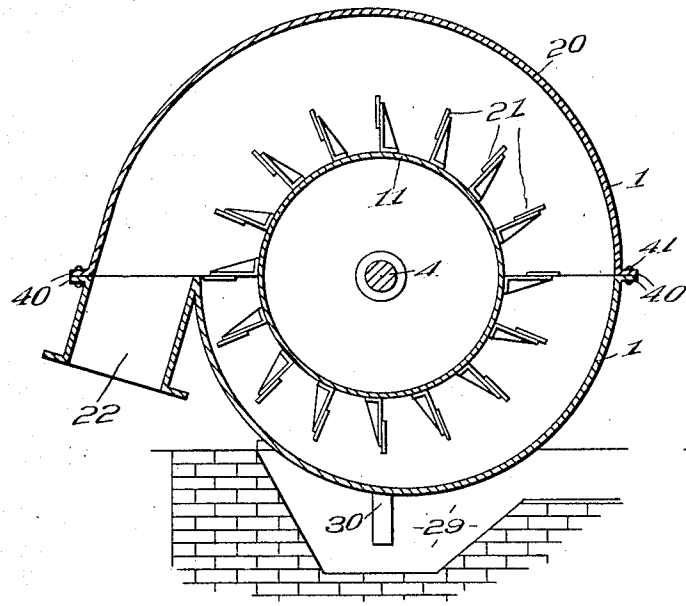


Fig. 4.

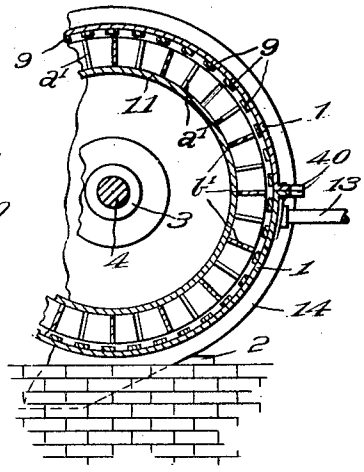


Fig. 5.

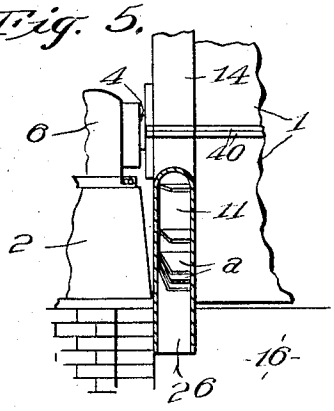


Fig. 8.

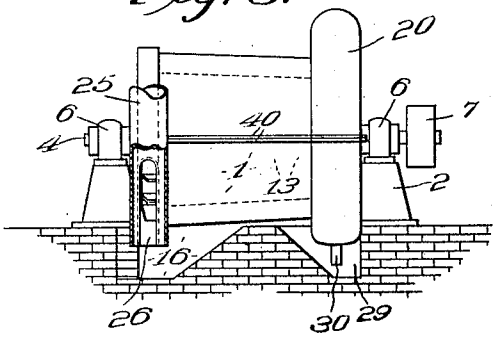


Fig. 7.

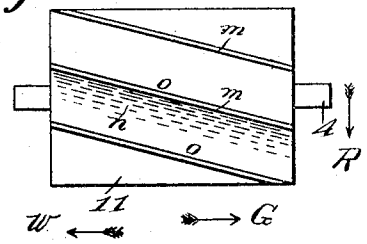
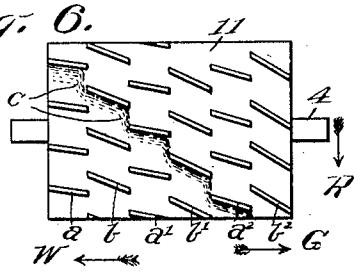


Fig. 6.



Witnesses

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UNITED STATES PATENT OFFICE.

GUSTAV SAALER, OF NEW YORK, N. Y.

GAS-WASHER.

No. 856,731. Specification of Letters Patent. Patented June 11, 1907.

Application filed December 27, 1906. Serial No. 349,691.

To all whom it may concern:

Be it known that I, GUSTAV SAALER, a subject of the German Emperor, residing at New York city, in the county of New York and State of New York, have invented new and useful Improvements in Gas-Washers, of which the following is a specification.

My invention relates to rotary gas washers, of the type in which a drum, carrying spiral wings, is rotated in a casing to force water through in one direction, while gas is being drawn through in the opposite direction.

It consists in certain new features whereby the construction and operation of the washer are much improved.

Heretofore washers of this general type have been used to some extent but have been uncertain in operation and not entirely successful, from defects which arose from an incorrect understanding of the principles involved. It will be understood that gases can be washed by passing them through a falling shower of water, but the amount of water used is so large and the process so slow as to prevent its commercial use; therefore, the adoption of these rotary washers, whose object is to purify large masses of gas quickly and continuously with the minimum of water and of power. As heretofore constructed they often clogged up and did not perfectly clean the gases, but permitted the passage onward to the piping and the gas engine of gas containing impurities and moisture. This is caused largely by the fact that the gases are brought into intimate contact with the water only toward the gas outlet end; while toward the gas inlet end, the machine is practically ineffective, for the water flows out around the circumference of the casing, while the gases are admitted at the end and toward the center, so that the gases are not brought in intimate contact with the spray or water-mist.

My invention consists in modifications in the preceding machines whereby they are improved and certain defects overcome. By my machine the gases are perfectly purified, even of their coloring matter, and are delivered from the exit end to the engine practically dry, and this is effected rapidly, without presenting obstacles to the flow of the gas and with the minimum of power and of water.

The particular features of my invention are

First to provide the rotating drum with several sets of short inclined wings alternately arranged through the length of the machine (instead of continuous wings), whereby the water passing from one set of wings to the next forms veils or sheets of fine spray or water-mist, through a plurality of which sheets the gas is forced to pass, without sensibly impeding its rate of flow.

Second to provide the casing on its interior with projections preferably in the form of longitudinal strips, and by arranging the wings to rotate in close proximity to said projections, whereby the tendency of the water to flow rapidly around, in contact with the casing and more or less ineffectively, is prevented; the rotating flow of the water is checked, and as it passes over the projections it is continually being broken up by the wings into water-mist and mixed with the gas; the particles of water-mist, having combined or united with the impurities, are constantly being driven centrifugally by the wings and back into the film of water, maintained on the surface of the casing; by arranging the strips longitudinally in the casing, the flow of the water toward the rear, or gas inlet end, of the machine is not impeded but promoted.

Third by admitting the gases at the circumference of the casing, where it is met by a stream of water-mist being driven forcibly down and in the opposite direction to the entering gases, by the wings. By these preliminary steps a large portion of the impurities, and those the heavier, are washed out before they can enter the washer, and the inflowing gases are also desirably moistened and cooled. Preliminary cooling is very important to prevent the conversion within the washer of the water into steam or vapor which would be otherwise mixed with the light impurities, to be carried forward into the piping and the engine. Such preliminary moistening of the gases is also of great importance, as the fundamental principle which I have discovered and on which the success of my washer depends, is to saturate the gas as completely as possible with mechanically formed fine spray or water-mist; this water-mist unites with the impurities in the gases, and then by the centrifugal force of the wings the water-mist and the impurities are driven toward the circumference, into the water film on the inner surface of the casing; the impurities are retained in

the film and flow out in the streams of water continually flowing forwardly between the strips to the water outlet, and the gas flows from the gas outlet substantially dry and practically perfectly purified, not only of the coarser impurities but even of the impalpable impurities which discolor certain gases.

Fourth, the arrangement of water seals at the gas inlet end and the outlet end, particularly the former. The gas being turned at a sharp angle, from the inlet pipe into the junction, a portion of the impurities particularly the heavier, fall by gravity into the seal; other impurities are immediately washed out by the down-pouring stream of water-mist at the inlet. No such provision was made in prior machines for separating out the heavier impurities, nor was there any water seal to receive them, but more or less of these impurities entered the machine, impeding its operation; some were deposited at the inlet, on the metal case at the bottom, where they clogged up the machine. The result was an irregular pressure, making necessary a gas-holder for regulating the pressure. Whereas a gas-holder is not necessary with my machine, that is for regulating the pressure, though of course it may be used for storage of the cleaned gas. The impurities may conveniently be cleaned from the seals and utilized for other purposes, without stopping the machine.

Finally, my entire machine is operative and effective from end to end with no waste space; toward the front of the washer there is a greater effect of breaking up the water and cleansing the gases, toward the rear where the wings are more inclined, less of that effect, and more to drive the water rearwardly, whereby the gas is dried.

My invention is fully shown in the drawing herewith, in which the reference letters and numerals of the description indicate the corresponding parts in all the figures.

Figure 1 is a longitudinal section of my gas washer. Figs. 2, 3 and 4 are cross sections thereof taken respectively on section lines *w*, *x*, *y*, of Fig. 1. Fig. 5 is a partial cross section taken on line *z* of Fig. 2. Fig. 6 is an elevation of the drum detached to show the arrangement of the wings. Fig. 7 is a diagram explaining Fig. 6 and illustrating an undesirable arrangement of wings. Fig. 8 is a side elevation with portions broken away to show a modification in the form of the casing. Figs. 9 and 10 are diagrams of a portion of the casing behind the drum to illustrate the arrangement and function of the strips.

In the figures, 1 indicates the fixed casing carried on suitable standards 2 and provided with stuffing boxes 3 for the shaft 4, journaled in bearings 6 and having a pulley 7, or other means, by which the shaft and the drum are rotated from any suitable source of power. The casing has on its inner surface suitable projections, preferably in the form of longitudinal strips 9 9.

On the shaft is fixed the drum 11 carrying several sets of inclined wings $a\ a'\ a^2$ and $b\ b'\ b^2$ arranged alternately, and preferably arranged at different inclinations as shown in Fig. 6, to be further described. These wings are inclined, and preferably spiral, so as to meet the water from the water inlet 13, and both break it up into fine spray or water-mist and direct it, between the casing and the drum, both centrifugally to the surface of the casing and longitudinally toward the water outlet and gas inlet at the front end, where it is received with the impurities, washed from the gases, and more or less in solution, into the water seal 16, having overflow 17 for the water. The heavier impurities, tar for instance, are more or less separated from the gases by the centrifugal force of the wings. These fall into the seal, whence they may be cleaned out from time to time.

In the enlarged rear end 20 of the casing is arranged the fan 21 for drawing the gas into and through the washer and driving it on through the pipe 22 to the gas engine, or to other point, where it is consumed or stored. The crude gases enter the washer from the cooler or the source of supply through pipe 25, and are turned at an angle into the enlarged junction 14, and thence to the inlet 26 where they are met by a heavy down-pour of the water-mist driven by the wings forcibly against the gas, by which the heavier impurities are carried down into the water-seal with the dirty washing water, and the gases further cooled and moistened as already described. As aforesaid, in changing direction some of the heavier and already moistened impurities fall by gravity in the water seal. From the fan casing extends down into the same, or another water seal 29, a pipe 30 to permit a drip of the trifling amount of water which sometimes enters and collects in the fan casing, particularly when the machine has been stopped.

The function and the preferred arrangement of the inclined wings is best shown in Fig. 6. These wings are necessarily arranged in separate sets with the wings of each set arranged alternately, or opposite the spaces between the wings of the preceding and succeeding set. The wings of the different sets are preferably arranged at different inclinations; for instance, six sets are indicated composed of two series $a\ a'\ a^2$ and $b\ b'\ b^2$, arranged alternately as shown; the sets of wings $a\ a'\ a^2$ are arranged at a less inclination to the axis than the sets $b\ b'\ b^2$, but the inclination of the three sets $a\ a'\ a^2$ gradually increases from front to rear and similarly the inclination of the three sets $b\ b'\ b^2$ also gradually increases from front to rear. The result is that, at the gas inlet end, as the wings are

at a lesser inclination, the water is moved more slowly toward the front, but there is the greatest effect of breaking the water up into water-mist, whereby the maximum intermixture of water-mist with the gas, and the maximum effect of washing out the impurities. But toward the rear or gas outlet end, by the greater inclination of the wings, a greater force is exerted to drive the water forwardly and a lesser force to break up the water into water-mist, whereby the water-mist is separated from the gases and the purified gas delivered dry.

By providing separate sets of wings and arranging them alternately on the drum, a series of veils or sheets of spray are created as the water passes from, or over, the rear edges of one set to the next set as indicated at C in Fig. 6, and the gas is forced to pass through these veils, and cannot escape. The importance of this is shown by Fig. 7 where *m* indicates the continuous wings extending from end to end of the drum. The water tends to accumulate in the front of each wing and to flow forward through the machine in a stream indicated by *n*. This leaves a space behind each wing indicated by *o*, containing little or no water-mist, and as the gas seeks the path of least resistance it will flow through these spaces *o* behind the wings, without coming to any great extent in contact with the water, and therefore with little cleansing effect. This has been the result in practice with machines having wings arranged as shown in Fig. 7.

Arrows R indicate the direction of rotation of the drum; arrows G, the direction of the gas flow; arrows W, the general direction of the water flow.

The strips have been described as being arranged longitudinally as shown in Fig. 9. This is a convenient arrangement. But the arrangement shown in Fig. 10 is also good. Here the inclination indicated by dotted lines, of the wings is to make clear how the arrangement of the strips, inclined in this direction, would promote, and not impede, the flow of the water forwardly toward the outlet. If the strips were inclined in the reverse direction, they would oppose the forward flow of the water and this machine would not operate.

The casing of my machine is preferably made in two parts provided with flanges 40 and bolts 41, so that the upper half may easily be removed for examination, repairs, etc. of the inner parts. I prefer to make my casing and drum cylindrical as it is simpler, but they could be made tapering as shown in Fig. 8.

I have used the term water-mist to indicate very fine spray produced by mechanical means in contradistinction to vapor and steam, produced by heat.

My invention not only cleanses the gases to a high degree as aforesaid, but does this quickly with the minimum of water, and attains a high degree of efficiency in proportion to the size of the machine.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. In a gas washer, the combination with a suitable casing having a gas outlet at its rear end, a water inlet adjacent to its rear end, a gas inlet and water outlet in the lower portion of its circumference at its front end, of a water seal arranged below said water outlet and forming the bottom thereof to receive the water and impurities from the washer, a suitable drum, inclined wings on the drum arranged to force the water centrifugally and forwardly, means to rotate the drum, and means to force the gas through the casing around the drum from front to rear.

2. In a gas washer, the combination with a suitable casing, of a drum journaled in the casing, said casing having a gas outlet at its rear end, a water inlet adjacent to its rear end and a gas inlet and water outlet at its front end, means to force the gas through from front to rear, means to rotate the drum, and inclined wings on the exterior of the drum to break up the water into mist and to force it both centrifugally and toward the front, said wings being arranged in a plurality of circumferential sets, with the wings of one set arranged opposite the spaces between the wings of the adjacent set or sets.

3. In a machine for washing gases, the combination with a casing having a gas inlet and a water outlet in the lower portion of its circumference at the front end, a gas outlet at the rear end and a water inlet adjacent to the rear end, of a drum rotating in the casing, and inclined wings on the periphery of the drum arranged to force the water centrifugally and toward the front.

4. In a machine for washing gases, the combination with a casing having a gas inlet and water outlet in its circumference at the front end, a gas outlet at the rear end and a water inlet adjacent to the rear end, of a drum rotating in the casing, and a plurality of separate sets of inclined wings on the periphery of the drum, said wings being inclined to force the incoming water forwardly and the sets toward the front being set at less inclination to the drum axis and the sets toward the rear set at a greater inclination.

5. In a gas washer, the combination with a casing circular in cross section, of a drum concentrically journaled in the casing, said casing having a gas outlet at its rear end, a water inlet adjacent to its rear end, and a gas inlet and water outlet at its front end, means to force the gas through from front to rear, means to rotate the drum, inclined wings on the exterior of the drum to break up the water into mist and to force it both centrifu-

gally and forwardly, said wings being arranged in a plurality of circumferential sets, with the wings of one set arranged opposite the spaces between the wings of the adjacent set or sets, said gas inlet and water outlet being in the lower portion of the casing circumference, and a water seal arranged below said water outlet.

6. In a machine for washing gases, the combination with a casing having a gas inlet and water outlet at the front end, a gas outlet at the rear end and a water inlet adjacent to the rear end, of a drum rotating in the casing, short, inclined wings on the periphery of the drum arranged to force the water centrifugally and toward the front, means to rotate the drum and means to force the gas through between the casing and the drum from front to rear, said wings being arranged in two series, each series being composed of a plurality of circumferential sets of wings, the wings of each set being uniformly inclined to the drum axis, but the sets of one series being more inclined than those of the other, and the sets of each series being progressively more inclined from front to rear, and the sets of one series being alternately arranged with those of the other, substantially as described and shown.

7. In a machine for washing gases, the combination with a casing having a gas inlet and water outlet in the lower portion of its circumference at the front end, a gas outlet at the rear end, a water inlet adjacent to the rear end, of a drum rotating in the casing, inclined wings on the periphery of the drum arranged to force the water centrifugally and toward the front, and of projections on the interior of the shell extending into close proximity with the wings to oppose the tendency of the water to rotate on the inner surface of the shell.

8. In a machine for washing gases, the combination with a casing having a gas inlet and water outlet at the front end, a gas outlet at the rear end, a water inlet adjacent to the rear end, of a drum in the casing, inclined wings on the periphery of the drum arranged to force the water centrifugally and toward the front, practically parallel strips arranged on the inner surface of the shell, to break the film of water clinging to the interior of the shell and to form channels promoting the flow of the water toward the front, means to draw the gas through from front to rear, and means to rotate the drum.

9. In a machine for washing gases, the combination with a casing having a gas inlet and water outlet in the lower portion of its circumference at the front end, a gas outlet at the rear end and a water inlet adjacent to the rear end, of a drum in the casing, inclined wings on the periphery of the drum arranged to force the water centrifugally and toward the front, continuous, practically parallel, longitudinal strips arranged on the inner surface of the shell, to break the film of water clinging to the interior of the shell and to form channels promoting the flow of the water toward the front, means to draw the gas through from front to rear, and means to rotate the drum.

10. In a gas washer, an inclosing casing circular in cross section, having a gas outlet at the rear end, a gas inlet and water outlet in the circumference at the front end and a water inlet adjacent to the rear end, and in combination therewith a journaled drum concentrically arranged in the shell and forming an annular chamber between the drum and the shell, said drum being substantially of equal length to the interior of the shell, series of separate wings arranged on the drum and said series extending from end to end of the drum, said wings being inclined so as to force the water both centrifugally and toward the water outlet, means to operate the drum, and means to force the gas through the washer from front to rear.

11. In a gas washer, the combination with an inclosing casing having a cylindrical main portion, an enlarged rear portion, a gas outlet in said rear portion, a water inlet adjacent to the rear end of the main portion, and a gas inlet and water outlet in the lower portion of the circumference at the front end, of a water seal below said water outlet, a shaft journaled concentrically in the casing, a cylindrical drum on the shaft within the casing, series of separate inclined wings on the drum to force the water forwardly, a fan on the drum arranged in said enlarged portion to force the gas rearwardly and means to rotate the drum, said wings extending from the extreme front end to the extreme rear end of said cylindrical portion of the drum.

12. In a gas washer, the combination with a suitable casing having a gas outlet at its rear end, a water inlet adjacent to its rear end and a water outlet and gas inlet in the lower portion of its circumference at its front end, a gas supply pipe at its front end, an enlarged connection between said pipe and the gas inlet, said pipe and connection being so arranged that the gas turns a sharp angle from the pipe into the connection, a water seal arranged below the water outlet and to form the bottom of said connection, a drum journaled in the casing, inclined wings on the drum to force the water rearwardly, means to rotate the drum and means to force the gas through the casing around the drum from front to rear.

13. In a gas washer, a cylindrical, metallic casing having an enlarged rear portion and having a gas outlet in said rear portion, a water inlet adjacent to its rear end and a gas inlet and water outlet in the lower portion of

the circumference at its front end, a water seal below said water outlet, a drip pipe in the bottom of said enlarged portion, a water seal for said drip pipe, a fan in said enlarged portion, a cylindrical, metallic drum journaled concentrically in the casing, inclined wings on the periphery of the drum to force the water forwardly, means to rotate the drum and means to rotate the fan to draw the gas through the casing around the drum from front to rear.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GUSTAV SAALER.

Witnesses:

ALFRED WILKINSON,

J. B. MILLWARD.