July 19, 1932. L. RANNEY 1,867,758

PROCESS OF DEGASIFYING COAL AND OTHER CARBONACEOUS MATERIAL IN SITU

Filed July 10, 1931 2 Sheets-Sheet 1

Fig. 1

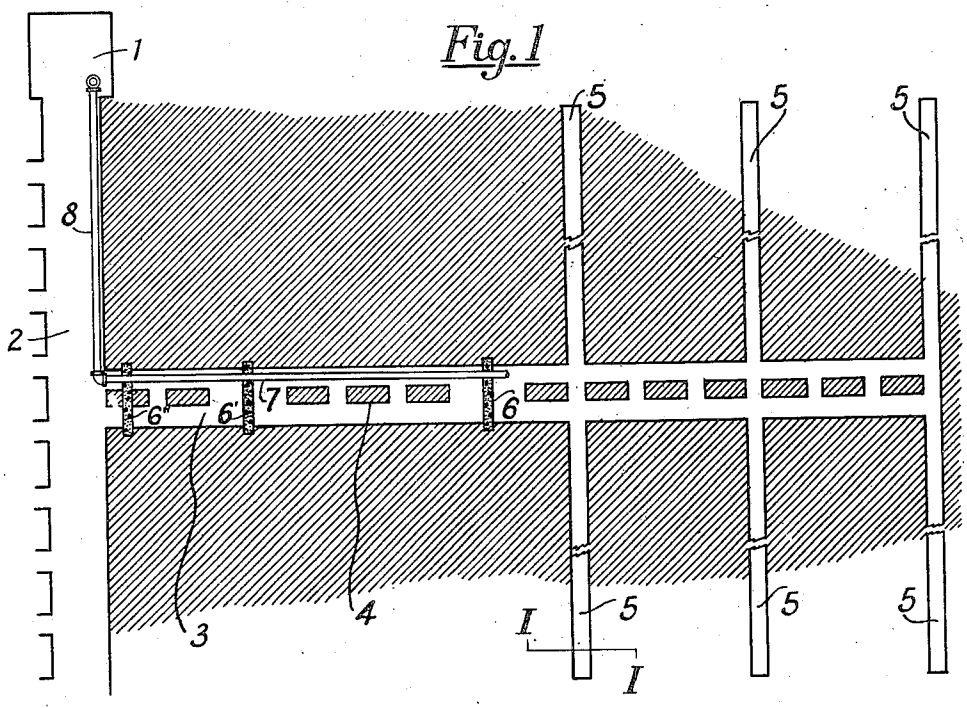

Fig. 2

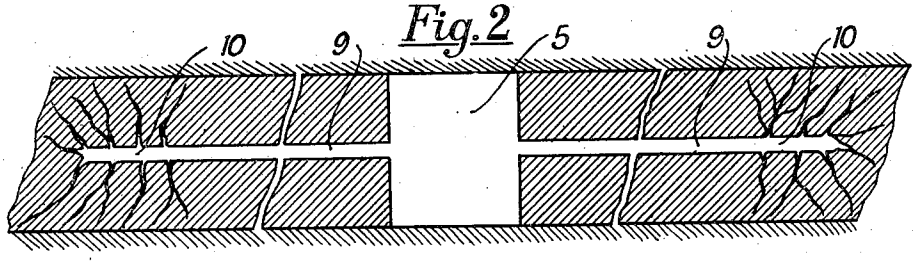

Fig. 3

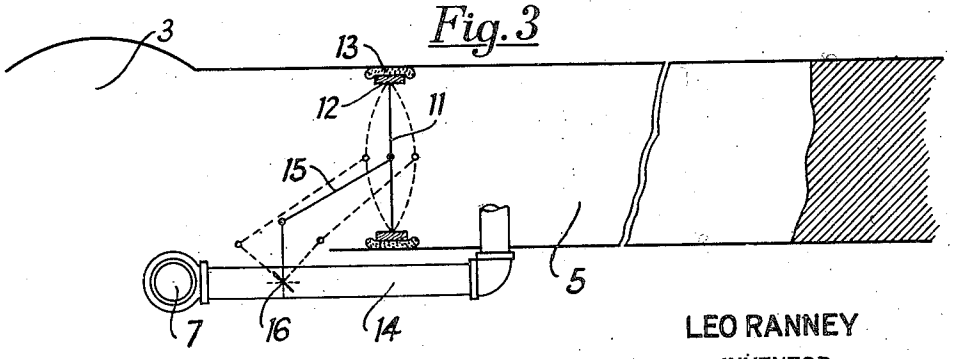

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Fig. 4

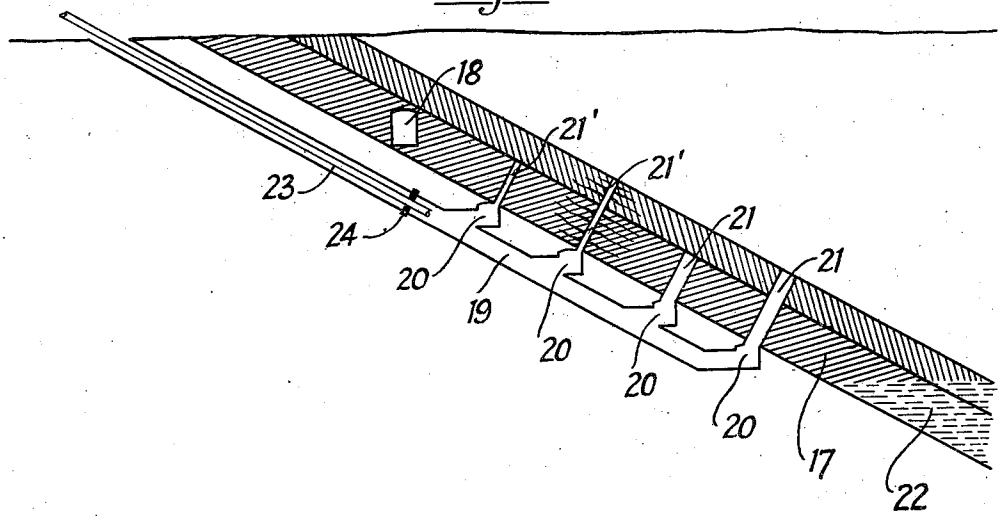
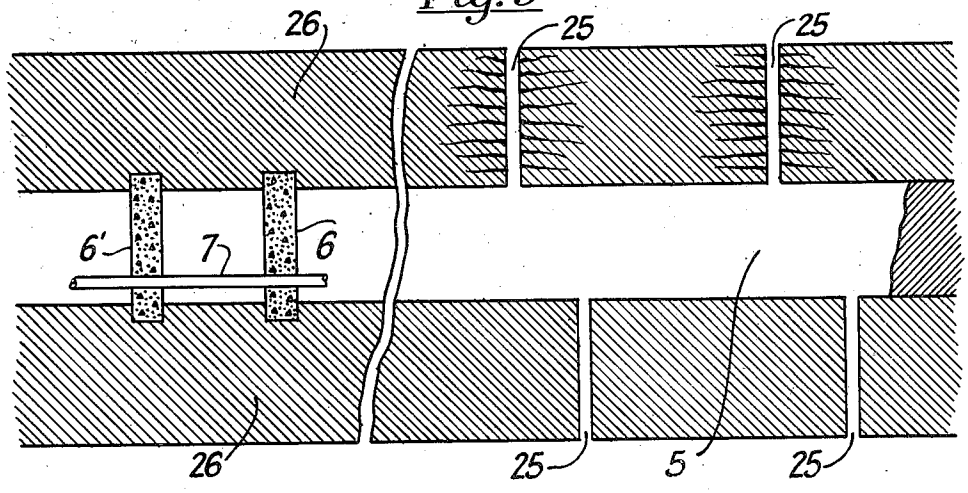


Fig. 5



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UNITED STATES PATENT OFFICE

LEO RANNEY, OF NEW YORK, N. Y.

PROCESS OF DEGASIFYING COAL AND OTHER CARBONACEOUS MATERIAL IN SITU

Application filed July 10, 1931. Serial No. 550,009.

This invention relates to improvements in the process of degasifying coal and other carbonaceous materials in situ.

The primary object of this invention is to provide a method for the removal of gas from an area in a coal seam or other porous bed prior to the extending of mining operations to that area.

A further object of the invention is to remove one of the ever present hazards to coal mining, that is, the collection of combustible gases in the workings, and to make available for use what is now a waste product in the industry.

A still further object of the invention is to provide a method for preventing the flow of gas from unworked areas, or from gas bearing strata adjacent thereto, into the workings of coal mines and thereby to reduce the cost of mine ventilation.

Heretofore, it has been proposed to remove mineral oil and gases from bituminous and gaseous deposits with the aid of movable air dams and by the drilling of bore holes into that part of the oil bearing deposit blocked off by the movable air dam. Such a method may be applicable to the removal of oil and gas from loosely consolidated deposits, such as oil sands and gravel, but is entirely impracticable in connection with the degasification of solid or highly consolidated gas bearing deposits, such as coal seams and shale, principally due to the fact that it does not provide adequate means to prevent the infiltration of air, nor does it expose sufficient surface areas for the exudation of the gas.

Gas reposing in an earth formation must lie within the pores between grains, if in a sand or gravel bed, but within coal seams by far the major percentage of gas to be found is occluded or absorbed within the coal itself and only a small part of the gas occupies the minute fissures, cleavage and bedding planes extending longitudinally and horizontally in the coal seam. This occluded or absorbed gas is driven off gradually during mining operations, so that it is a continuing hazard to workmen and a handicap to mine ventilation, and the loss of it is a waste of a natural resource. It is not unusual to encounter conditions where each ton of virgin coal in situ will contain upwards of 2000 cu. ft. of gas.

My process comprises the removal of gas from any area in a coal seam or other porous bed previous to the commencement of mining operations in that area or in the removal of gas coincidental with the extending of the workings of the mine.

With the foregoing objects outlined and with other objects in view, which will appear as the description proceeds, the invention consists of the novel features hereinafter described in detail, illustrated in the accompanying drawings and more particularly pointed out in the appended claims.

In the drawings:

Figure 1 is a plan view of a degasification system located adjacent to the old workings of a coal mine.

Figure 2 is a vertical section through one of the sapping drifts of the degasification system taken on the line 1—1 of Figure 1.

Figure 3 illustrates means for temporarily sealing the sapping drifts during the construction of the degasification system.

Figure 4 is a vertical section showing a modified form of the invention as applied to the removal of gas from an area of a coal seam lying below the economic limit of coal mining operations.

Figure 5 is a vertical section showing a modified form of the invention as applied to the removal of gas from the rock adjacent to a coal seam.

Referring to the drawings, 1 represents a shaft leading to the workings 2 of a coal mine. From the workings 2, I drive a tunnel 3 into or adjacent to the coal seam comprising the area to be degasified, leaving sufficient coal or rock pillars 4 for the support of the roof. This tunnel, during the course of construction, may if necessary be ventilated by any usual means, such as a brattice and blower, not illustrated.

Having constructed the tunnel 3 of any desired length, I then extend from the tunnel 3 into the coal area to be degasified, sapping tunnels 5 which may be from 250 to 2000 ft. or more in length, depending upon the area to be

degasified and which may be of a size capable of use as haulage ways when mining operations are to be commenced after degasification. The first sapping tunnel of the system should be located a sufficient distance from the old workings to prevent the infiltration of air therefrom into the degasification system. In particularly gaseous areas, it may be found advantageous to temporarily seal the sapping drifts 5 at their entrance into the tunnel 3, to prevent loss of gas and to simplify the ventilation of the tunnel 3.

Referring now to Figure 2, it may be found desirable in certain instances to increase the exposed surface of the coal to be degasified by making borings 9 from the sapping tunnels 5 into the coal seam and in some instances, particularly where subsequent mining of the coal is not intended, to place explosive charges in the bore holes at 10 and to shoot them for the purpose of breaking up the coal seam and exposing larger surfaces. Ordinarily, it is better practice to shoot the explosive charges after completion of the degasification system, but prior to completely sealing same.

Having completed the tunnel 3, sapping tunnels 5 and such borings 9 as may be desirable, I then construct, preferably of concrete poured under pressure, one or more barriers 6, 6′ and 6″, in the open end of the tunnel 3 nearest the old workings of the mine or the shaft as the case may be. A pipe 7 is extended either from the shaft or from the old workings through the barriers 6, 6′ and 6″ into the tunnel 3 and is connected through a suitable pipe 8 to exhausting pumps and gas reservoirs, not illustrated, located on the surface of the ground.

I have found that the installation of the barriers, 6, 6′ and 6″ of concrete or other substantially impervious material is not always sufficient to prevent the infiltration of air around the barriers when a partial vacuum is placed on the degasification system. In cases where the coal seam consists of a relatively non-porous mass, the infiltration of air around the barriers 6, 6′ and 6″ may be prevented by coating the surface of the coal in the tunnel 3 between the barriers with gunite and/or asphalt paint, also by extending the gunite or asphalt paint coating along the surface of the coal at the end of the tunnel 3 communicating with the shaft or old workings of the mine, and in some cases along the face of coal in the old workings nearest to the sapping or degasification system.

However, in some instances, it will be found that a coating of gunite or asphalt paint will not be sufficient to prevent the infiltration of air. In such instances, I propose to fill the tunnel 3 between the barriers 6 and 6′, and 6′ and 6″ with a mixture of mud and crude oil or some other plastic material and in some cases to maintain it under pressure. Upon placing the degasification system under partial vacuum, the mud or other plastic material will flow into the seams and crevices of the coal face adjacent to the walls of the tunnel 3 and effectually seal the degasification system against the infiltration of air.

Having completed the degasification system and sealed the tunnel 3 against the infiltration of air, the degasification system, provided the gas pressure is not sufficient to deliver the gas to storage reservoirs, is placed under partial vacuum and the gas exhausted through the pipe 7 and delivered to the surface through pipe 8. It may be found necessary to discard some of the first gas withdrawn from the degasification system, as it may be diluted with air and of small commercial value. As soon as the air content of the gas becomes sufficiently low, the gas exhausted from the workings may be conducted to any suitable reservoir for future use.

Referring now to Figure 3, I illustrate means for temporarily sealing the lateral sapping tunnels 5 during the construction of the degasification system. A flexible curtain 11 of rubberized or other material substantially impervious to gas, which is attached on all four sides to adjustable plates 12 which cooperate with the rubber gaskets 13, is placed in the end of the drift 5 communicating with the tunnel 3, and the plates 12 and the rubber gaskets 13 are compressed against the walls, roof and floor of the tunnel 5 by any suitable means, to effect a temporary seal substantially impervious to the flow of gas and air. In the floor of the tunnel 5, I embed a short pipe 14 with an upwardly extending elbow. The other end of the pipe 14 passes out beyond the temporary seal in the sapping tunnels 5 into tunnel 3 and is connected to the main gas line 7, which is connected by the pipe 8 to a suitable exhauster on the surface of the ground.

The curtain 11 is purposely made slack and is attached at its center to lever 15 which operates the damper or butterfly valve 16 located in pipe 14.

When the gas pressure in the sapping drift 5 balances the air pressure in the tunnel 3, the curtain 11 hangs slack, but as the gas pressure in the sapping drift increases, the curtain is caused to bulge outward toward the main tunnel and to open the butterfly valve or damper 16 in pipe 14, thus permitting the application of a vacuum for the removal of the excess gas from tunnel 5. When the gas pressure in the lateral 5 is again equalized with the air pressure in tunnel 3, the valve is automatically closed or partially closed by the inward movement of the curtain 11. In the event the vacuum becomes too high, the curtain 11 will be drawn inward, and will close the valve 16 and permit the pressure to again be equalized. This temporary sealing means is removed upon the completion of the

degasification system and prior to sealing of tunnel 3.

Figure 4 illustrates a modification of the process particularly adaptable to steeply dipping carbonaceous beds but which may be applied to any coal seam having rock adjacent thereto. 17 is a coal seam and 18 the lowest level of the coal mining workings therein. 19 is a shaft driven in the rock adjacent to the coal seam to a point considerably lower than the lowest workings and leading to the sapping tunnels 20 extending substantially at right angles to the shaft and substantially parallel to the strike of the coal seam. 21 and 21′ are sapping tunnels and bore holes drilled from the tunnels 20 through the intervening rock and to and through the coal seam itself. These sapping tunnels or bore holes may be spaced at intervals of 20, 40 or 60 feet or more, depending upon conditions encountered.

During construction the sapping tunnels 21 may if desired be temporarily sealed as previously described. Holes 21′ may, if desired, be loaded with explosives and the mouth of the hole leading into the sapping tunnel sealed to prevent the escape of gas thereinto during development work.

Electric wiring, not illustrated, is extended through the barrier 24 and to the surface of the ground to enable the charges to be exploded one at a time after the degasification system has been installed. The shooting of the holes blows out the seals and establishes open communication with the sapping tunnels and at the same time fractures the coal about the holes and thereby exposes a large area for the exudation of gas therefrom into the sapping tunnels.

In cases where a water table 22 exists within the coal seam at a distance below the level of these sapping tunnels, if the water table has a tendency to rise as gas is removed from the coal seam above it, advantage is taken of this fact and the water is utilized to lift the gas through the coal seam toward the row of tunnels 21 and bore holes 21′ through which gas is produced.

Degasification pipe 23 is extended downward in the shaft to draw gas from the degasification system. A barrier 24 or heavy bulkhead of concrete surrounds the pipe. Through this seal is a manhole, not illustrated, through which the gases of explosion from the firing of charges in the holes 21′ are allowed to escape. When all these charges have been fired, preferably one at a time, the manhole is closed and a seal of mud or other plastic or impermeable substance is placed in the shaft directly above the concrete bulkhead 24 to prevent the infiltration of air into the degasification system. Suction is then applied to the above ground end of pipe 23, and a partial vacuum created in the tunnels 20 and 21 and holes 21′, the gas from the coal seam being delivered through pipe 22 to suitable reservoirs.

In some instances, it will be found that gas is not only occluded in the coal seam, but in the roof rock and floor rock above and below the seams. In such cases, it will be necessary to provide means not only for the removal of the occluded gas from the coal seam but for the removal of the interstitial gas from the roof and floor rock.

Referring now to Figure 5, 5 is a sapping tunnel in the coal seam similar to those illustrated in Figure 1. From the sapping tunnel, I drill bore holes 25 beyond the coal seam into the roof and floor rock adjacent thereto, and if the floor and roof rock 26 are not sufficiently porous to permit relatively easy flow of gas into the bore holes 25, I place explosive charges therein and then explode them to cause a fracture in the rock and thus expose additional area for the flow of gas therefrom. The gas is then exhausted as herein previously described.

By the above process, practically all of the gas occluded in the coal area which it is desired to degasify may be removed in advance of the commencement of mining operations and saved, and at the same time prevented from filtering into the workings.

From the above description taken in connection with the drawings, it is believed that those skilled in the art will clearly understand the present invention, and it is manifest that changes may be made in the details disclosed without departing from the spirit of the invention as expressed in the claims.

What I claim and desire to secure by Letters Patent is:

1. The process of extracting methane gas from coal deposits in situ which process consists in constructing a tunnel system consisting of one or more tunnels in the area of the coal deposit to be degasified, sealing said area against the infiltration of atmospheric air, placing the sealed area under partial vacuum and removing the occluded gas from the coal deposit.

2. The process of extracting methane gas from coal deposits in situ which process consists in constructing a tunnel system consisting of one or more tunnels into the area of the coal deposit to be degasified, drilling bore holes from the said tunnels into the coal deposit, placing explosive charges in the bore holes and exploding same to expose large surfaces of the coal, sealing said area against the infiltration of atmospheric air, placing the sealed area under partial vacuum and removing the occluded gas from the coal deposit.

3. The process of extracting methane gas from coal deposits in situ, which process consists in constructing one or more tunnels in the rock adjacent to the coal seam to be degasified, driving spaced tunnels from the tunnels in the rock into the coal seam, sealing the degasification system comprising the tunnels

in the rock and spaced tunnels in the coal seam against the infiltration of atmospheric air, placing the degasification system under partial vacuum and removing the occluded gas from the coal seam.

4. The process of extracting methane gas from coal deposits in situ which process comprises constructing a tunnel system consisting of a tunnel and connecting sapping tunnels into the coal deposit to be degasified, sealing the open end of the tunnel system against the infiltration of atmospheric air, placing the sealed tunnel system under partial vacuum and removing the occluded gas from the coal deposit.

5. The process of extracting methane gas from coal deposits in situ which process consists in constructing a tunnel system consisting of one or more tunnels into the area of the coal deposit to be degasified, constructing two or more spaced barriers in the open end of the tunnel system, filling the space between the barriers with a plastic material substantially impervious to the flow of air and gas, placing the sealed tunnel system under partial vacuum to cause the plastic material to flow into the crevices and pores of the coal face adjacent to the barriers to prevent the infiltration of atmospheric air and removing the occluded gas from the coal deposit.

6. The process of sealing a tunnel system in a coal deposit against the infiltration of atmospheric air, which process consists in constructing in the open end of the tunnel system, two or more spaced barriers, and filling the space between the barriers with a plastic material substantially impervious to the flow of air and gas.

7. The process of sealing a tunnel system in a coal deposit against the infiltration of atmospheric air, which process consists in constructing in the open end of the tunnel system, two or more spaced barriers, and filling the space between the barriers with a plastic material substantially impervious to the flow of air and gas and maintaining the plastic material under pressure.

8. The process of sealing a tunnel system in a coal deposit against the infiltration of atmospheric air, which process consists in constructing in the open end of the tunnel system two or more spaced barriers and filling the space between the barriers with a plastic material substantially impervious to the flow of gas and air and placing the tunnel system under partial vacuum to cause the plastic material to flow into and fill the crevices of the coal face adjacent to the barrier.

9. The process of constructing a degasification system in a gas bearing coal seam, which process consists in constructing a tunnel into the coal seam, constructing communicating spaced tunnels from said tunnel into other parts of the coal seam, temporarily sealing the spaced tunnels to prevent the escape of gas, removing the temporary seals of the spaced tunnels and sealing the degasification system against the infiltration of atmospheric air.

10. The process of constructing a degasification system in a gas bearing coal seam, which process consists in constructing a tunnel into the coal seam, constructing communicating spaced tunnels from said tunnel into other parts of the coal seam, temporarily sealing the spaced tunnels to prevent the escape of gas, automatically equalizing the pressure of gas in the spaced tunnels with the pressure of atmospheric air in the main tunnel, removing the temporary seals of the spaced tunnels and sealing the degasification system against the infiltration of atmospheric air.

11. The process of extracting methane gas from coal deposits in situ, which process consists in constructing sapping tunnels below the coal seam to be degasified, drilling spaced bore holes from the sapping tunnels into and through the coal seam, sealing the sapping tunnels and bore holes against the infiltration of atmospheric air, placing the degasification system consisting of the sapping tunnels and bore holes under partial vacuum and removing the occluded gas from the coal seam.

12. The process of extracting methane gas from coal deposits in situ, which process consists in constructing sapping tunnels below the coal seam to be degasified, drilling spaced bore holes from the sapping tunnels into and through the coal seam, placing explosive charges in the bore holes, temporarily sealing the bore holes to prevent the escape of gas into the sapping tunnels, exploding the explosive charges to fracture the coal seam and break the temporary seals, sealing the degasification system comprising the sapping tunnels and bore holes against the infiltration of atmospheric air, placing the degasification system under partial vacuum and removing the occluded gas from the coal seam.

13. The process of extracting methane gas from gas bearing rock adjacent to a coal seam, which process comprises constructing a tunnel into the coal seam, drilling bore holes from the tunnel into and through the coal seam and into the gas bearing rock, sealing the open end of the tunnel against the infiltration of atmospheric air, placing the degasification system comprising the tunnel and bore holes under partial vacuum and removing the gas from the gas bearing rock.

14. The process of extracting methane gas from a coal seam and the gas bearing rock adjacent thereto, which process comprises constructing one or more tunnels into the coal seam drilling bore holes from the tunnels into and through the coal seam and into the gas bearing rock, sealing the tunnel system against the infiltration of atmospheric air,

placing the degasification system comprising the tunnel system and bore holes under partial vacuum and removing the gas from the occluded coal seam and interstitial gas from the gas bearing rock adjacent thereto.

15. The process of extracting methane gas from gas bearing rock adjacent to a coal seam, which process comprises constructing a tunnel into the coal seam, drilling bore holes from the tunnel through the coal seam into the adjacent rock placing explosive charges in the bore holes exploding the charges to fracture the rock, sealing the degasification system comprising the tunnel and bore holes against the infiltration of atmospheric air, and removing the gas from the gas bearing rock.

In testimony whereof, I have signed this specification.

LEO RANNEY.