Oct. 25, 1938. W. M. TELFORD 2,134,492

UPDRAFT GAS PRODUCER

Filed Nov. 20, 1936 3 Sheets-Sheet 1

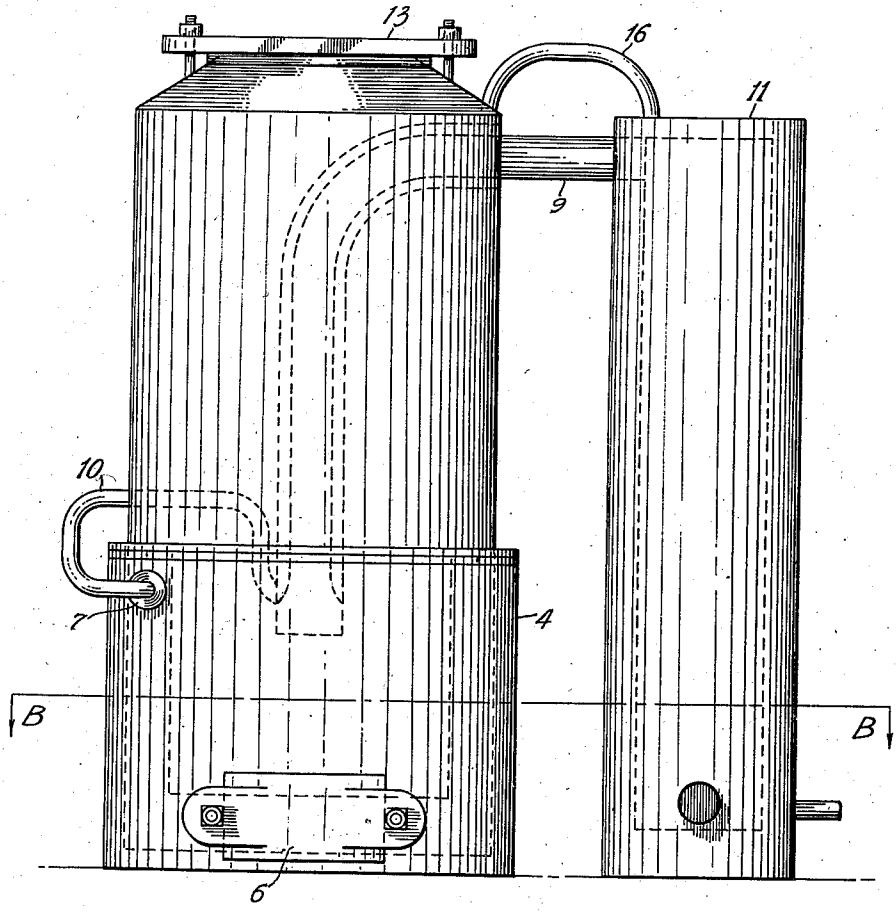


Fig. 1.

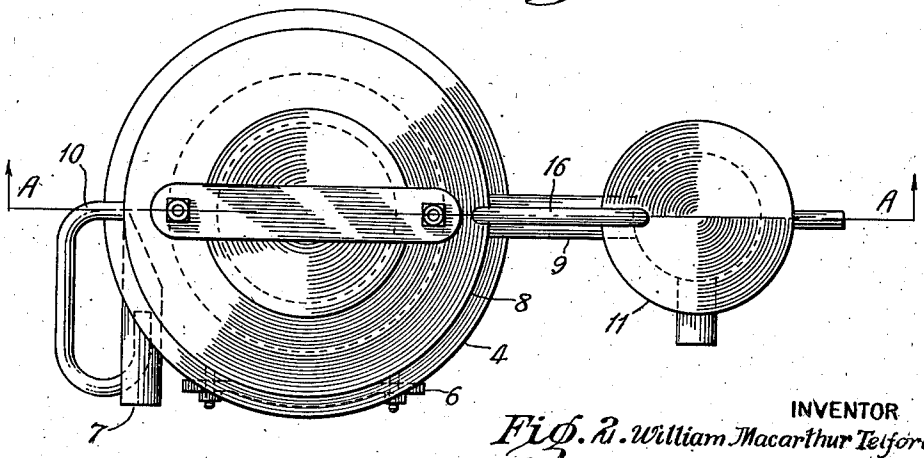


Fig. 2.

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UPDRAFT GAS PRODUCER

Filed Nov. 20, 1936 3 Sheets-Sheet 2

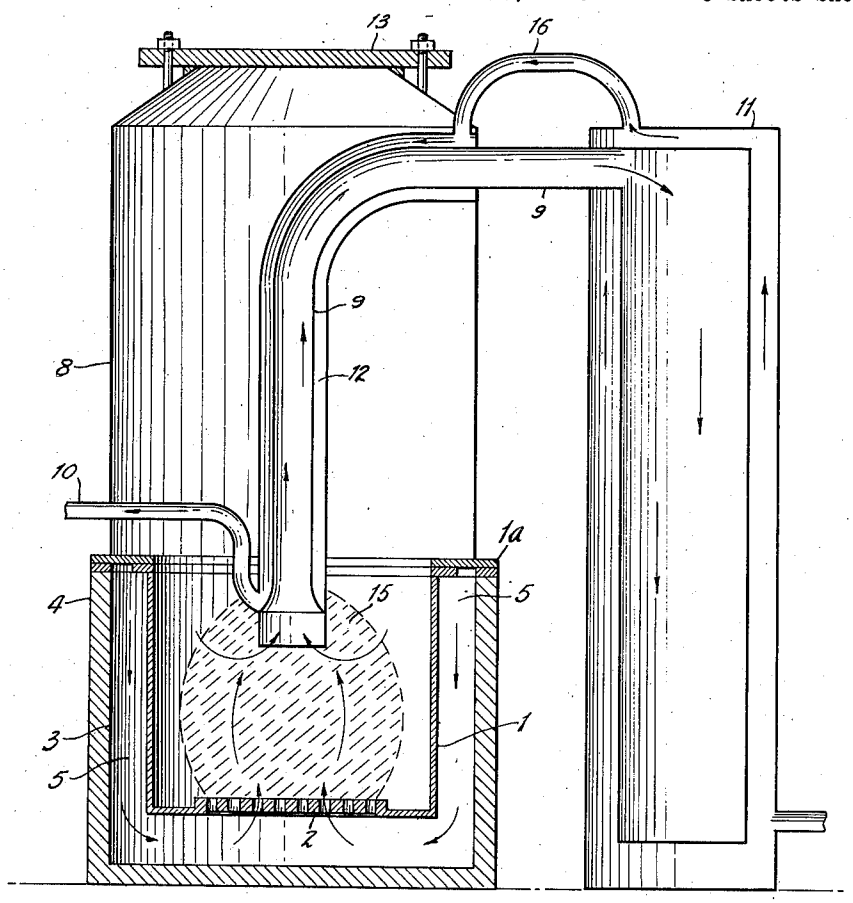


Fig. 3.

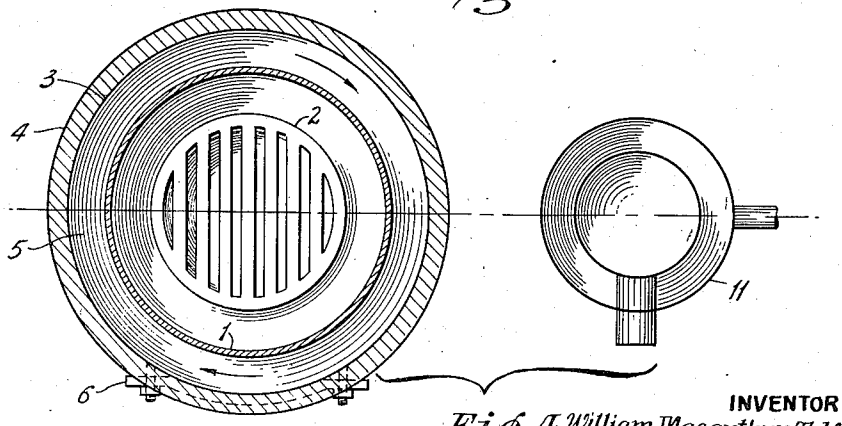


Fig. 4.

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UPDRAFT GAS PRODUCER

Filed Nov. 20, 1936 3 Sheets-Sheet 3

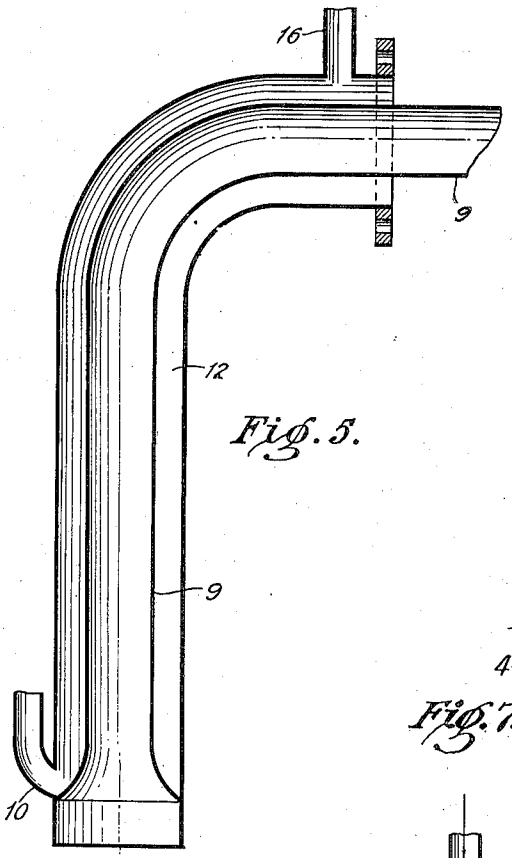


Fig. 5.

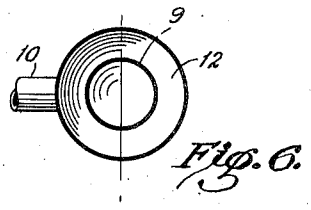


Fig. 6.

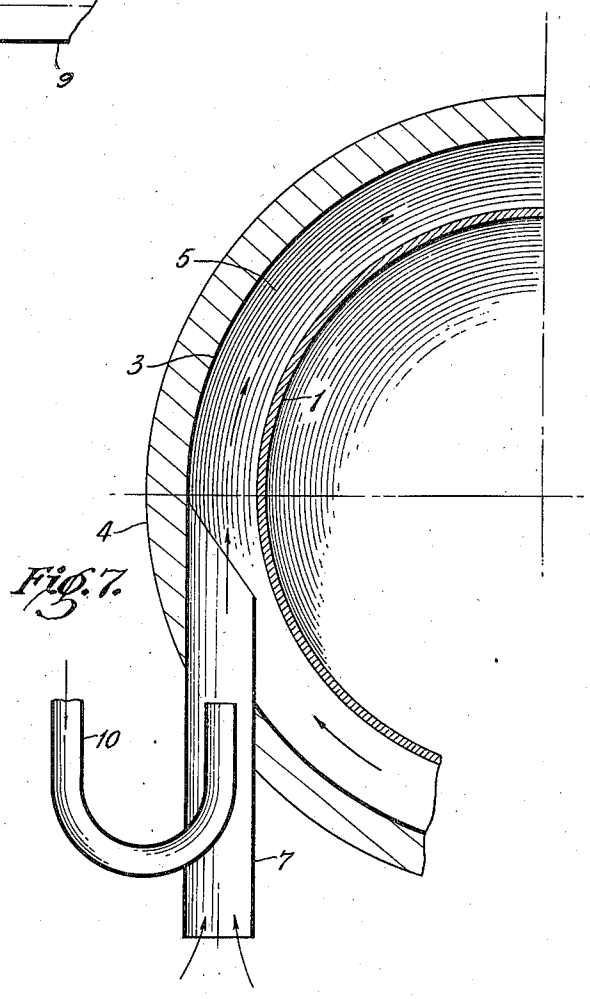


Fig. 7.

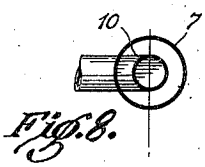


Fig. 8.

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Patented Oct. 25, 1938

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UNITED STATES PATENT OFFICE

2,134,492

UPDRAFT GAS PRODUCERS

William Macarthur Telford, Warwick, Queensland, Australia

Application November 20, 1936, Serial No. 111,817
In Australia December 3, 1935

1 Claim. (Cl. 48—76)

This invention relates to improvements in the production of combustible gas from carboniferous substances, more particularly from wood, bituminous coal and similar fuels, which give off by destructive distillation a large proportion by weight of steam or hydrocarbon vapors or both when heated to moderate temperatures; and the objects of my improvements are, first, to improve the construction of gas producing apparatus of the updraft type, so that wood and carboniferous fuels may be used for the production of gas, and the gas produced will be substantially free from tars and other hydrocarbon vapors; second, to provide means for the production of gas of a high calorific value, and which will enable a high thermal efficiency to be obtained when using fuels such as wood which may give off approximately 50% or more by weight of steam on destructive distillation; third, to obtain a high gas-making capacity per unit volume of the furnace, without the deterioration in the gas producer parts that has hitherto taken place when operating under such conditions; fourth, to obtain the automatic production of semi-water gas of uniform quality when fuel is gasified at variable rates, without the use of parts requiring skilled adjustment while in service; and, fifth, to attain the foregoing objects in a gas producer suitable for attachment to a motor vehicle. Minor objects are disclosed in the following description of my invention.

I attain these objects by the mechanism illustrated in the accompanying drawings, in which:—

Figure 1 is a side elevation of a gas producer constructed according to my invention;

Figure 2 is a plan view of the aforesaid producer;

Figure 3 is a central, vertical section of the gas producer taken on the line A—A of Figure 2;

Figure 4 is a horizontal section taken on the line B—B of Figure 1;

Figure 5 is a detail sectional view of the gas delivery pipe;

Figure 6 is a bottom end elevation of said pipe;

Figure 7 is a detail sectional view showing the arrangement of the steam air injector with respect to the furnace and outer casting, and

Figure 8 is an end elevation of a portion of Fig. 7.

Similar numerals refer to similar parts throughout the several views.

The gas producer comprises a cylindrical furnace 1, provided with an outer thermally insulated casing 3, a grate 2 fitting into the bottom of the furnace 1, a steam-air injector pipe 7, a hopper 8 having a lid or other attachment 13, a gas outflow and delivery pipe 9 passing down through the hopper, a steam delivery pipe 10 and a boiler 11 heated by the gas produced.

A cover-flange 1a is marginally rested upon the rim of the casing 3, and the furnace 1 is pendent from said flange at the approximate inner periphery of the latter.

The furnace 1 which is cylindrical in cross section may have parallel or tapered sides. This is open at its upper end into a hopper 8 and is fitted at the lower end with a flat or dished bottom. The furnace is not lined with refractory materials and may be constructed of mild steel plate since it does not have to withstand high temperatures. Fitted into the furnace bottom is a grate 2 which is substantially smaller in size than the bottom of the furnace and preferably corresponds in shape to the cross section of the furnace, the essential feature being that the walls of the furnace are separated from the grate by an intervening layer of fuel greater in thickness than the depth of the primary reaction zone. By this arrangement the furnace walls are maintained at a comparatively low temperature and it is unnecessary to line the furnace with heat resisting materials or to use special materials for its construction. This grate may be of a fixed or rocking type depending on the class of fuel it is intended to use. The construction and arrangement of these parts in one form is illustrated in Figures 3 and 4.

The sides and bottom of the furnace are enclosed by an outer casing 3 with an intervening air space 5 between these parts. The casing is constructed of sheet metal and lagged on its exterior with thermal insulating material 4. Fitted to the bottom of the casing 3 is an airtight door 6 and fitted to the upper end of this casing is a steam-air injector 7 of known construction. The injector 7 is fitted with its axis parallel to a tangent of the circumference of the casing 3 and communicates with the space 5. The outer tube of the injector 7 may communicate with the atmosphere, or be attached to a suitable blower, and the inner tube of this device communicates with the steam pipe 10. By means of the device 7 and its arrangement the air and steam entering the producer is rapidly circulated around the outside of the furnace 1 before admission through the grate 2 to the interior. The space 5 must be free from obstructions. Figure 6 is a sectional plan showing details of the construction and position of the steam-air injector 7 with respect to the casing 3 and furnace 1.

Attached to the top of the furnace 1 and casing 3 by means of a suitable air-tight joint is a hopper 8 constructed of sheet metal. Fitted at the top of the hopper 8 is a lid 13 or other suitable arrangement of known construction for the introduction of fuel and for the prevention of the passage of gases when closed. Attached to and passing through the side or top of the hopper 8 is a gas delivery pipe 9 of special arrangement and construction, as shown in sectional elevation in Figure 5 and in position in Figure 3. Exteriorly to the producer proper the pipe 9 communicates with a boiler 11 of known construction which is designed for the generation of steam from the heat in the gas produced. Inside the producer the pipe 9 is arranged with its lower end concentric with the axis of the furnace 1, and terminates below the top of the furnace 1 some distance above the grate 2, which distance is determined by the size of the producer and the fuel it is mainly intended to use. With the exception of a short length at the lower end, the pipe 9 is enclosed in an outer casing leaving an intervening space 12. At the upper end the space 12 is connected by the pipe 16 to the boiler 11, and at the lower end the space 12 is connected by the pipe 10 to the inner tube of the injector 7. The lower unjacketed portion of the pipe 9 is at a dull red heat when the producer is working, and for this reason is constructed of heat resisting steel, but as it is immersed in a reducing atmosphere the deterioration in service is very slight.

To operate the producer, a fire is started on the grate 2 with the door 6 and lid 13 open, air being supplied by the natural induced draught. When the fire is well alight, the furnace is filled to above the bottom of the pipe 9 with charcoal or coke and the hopper 8 is then filled with fuel such as wood, which it is proposed to use. Afterwards both the door 6 and lid 13 are closed and the producer is now ready for service.

Due to the difference in diameter between the grate 2 and furnace 1, the incandescent zone of the fire does not extend to the furnace walls, but is localized as shown by the hatched area 15 in Figure 3. The comparatively cool fuel between the incandescent zone and the furnace walls acts as an excellent heat insulator and prevents overheating of the furnace, or other parts of the producer. The air supply required for combustion enters through the injector 7 either by means of pressure due to a blower of known construction or alternatively due to the lowering of pressure inside the producer by suction on the gas delivery outlet. Due to the high velocity and direction of entry of the air into the space 5, the air is given a rapid circulation in the space 5, thus absorbing any heat that reaches the exterior of the furnace 1 from the incandescent zone. The further transference of this heat to the atmosphere is prevented by the thermal insulation 4 on the exterior of the casing 3. The air enters the grate itself preferably at comparatively low velocity as in standard practice. The ability to use ordinary materials of construction for the furnace without the use of heat resisting lining is due to separation of the edge of the grate from the furnace walls by the thickness of fuel mentioned, and does not depend on any other factor, except to a minor extent.

The circulation of air round the furnace and the provision of the outer insulated casing are designed primarily to prevent radiation of heat from the furnace to the atmosphere.

The lower end of the pipe 9 is arranged so that the gas produced leaves the producer from immediately above the secondary reaction zone, and from a part of the furnace interior where the fuel is incandescent. As the cooling jacket does not extend to the lower end of the pipe 9, the fuel around the inlet of the pipe remains incandescent. By this arrangement all gases and vapours must come in contact with incandescent surfaces before they leave the producer, thus converting substantially all vapours such as tar and other hydrocarbons into permanent gases. The arrangement of the gas delivery pipe 9 as herein specified allows the use of fuels such as wood since the steam distilled from the fuel does not come in contact with and lower the temperature of the reaction zones, as when this fuel is used in producers of the inverted combustion type.

The gas produced in passing through the boiler 11 generates steam in proportion to the quantity and temperature of the gas. The steam so generated is delivered by the pipe 16 to the space 12 surrounding the pipe 9 where it is superheated. The superheating of the steam in this manner serves the purpose of maintaining the pipe 9 at a moderate temperature and also of increasing the thermal efficiency of the producer. Delivery of the superheated steam is made to the injector 7 by means of the pipe 10 communicating with the lower end of the space 12, and serves the purpose of reducing the mechanical power required to operate the producer.

In order that the construction and operation of the producer may be more clearly understood, feathered arrows are placed on the drawings to indicate the direction of flow of the steam and gases.

It is known by those skilled in the art that considerable difficulty has been experienced in the use of such fuels as wood that give off on destructive distillation a high percentage by weight of steam and/or hydrocarbon vapours when heated to moderate temperatures.

In the type of producer known as the up-draft as hitherto constructed, such tars and hydrocarbon vapours as are carried off from the top of the fuel bed are difficult to remove from the gas produced. When such producers are used for the production of gas from fuels containing volatile constituents, costly apparatus is required for the removal of the hydrocarbon vapours from the gas, and this apparatus requires a considerable amount of attention while in service.

The inverted combustion type of producer, in contra-distinction to the up-draft type, possesses the advantage of producing clean gas, since all tars and hydrocarbon vapours distilled off must pass through an incandescent bed of fuel, where they are converted into permanent gases. This type of producer has a low thermal efficiency due to loss of unburnt fuel, and to the small amount of heat which may be recovered in practice from the gas produced. When fuels such as wood that give off approximately 50% or more by weight of steam on destructive distillation are used, the steam coming in contact with the incandescent fuel cools the furnace below the temperature required for efficient operation, consequently the gas produced has a comparatively low calorific value.

When gas producers as hitherto constructed are operated at high ratings, wear and deteriora-

tion of their parts takes place at comparatively rapid rates.

The gas producer constructed according to my invention, as hereinbefore described, operates on the up-draft system and retains the advantages hitherto associated with this system, but at the same time any tars and vapours produced are converted into permanent gases in the manner hitherto only associated with producers of the inverted combustion type. Producers constructed according to my invention may be operated at much higher ratings than has hitherto been the practice, without appreciable deterioration in the gas producer parts.

Other features of my invention lie in the arrangements for maintaining the gas delivery pipe at a moderate temperature by circulating a cooling medium through a jacket surrounding the major length of this pipe; preventing radiation of heat from the producer; obtaining a high thermal efficiency by a maximum heat recovery from the gas produced; and the production of gas of a high calorific value by using superheated steam.

It can be seen from the foregoing description of the construction and operation of the producer that by the combination and arrangement of apparatus as described, a gas producer constructed according to my invention is very simple in construction and easy to operate, and that it attains the objects set forth in this specification.

I claim:—

A gas producer comprising a casing, a cover-flange which is marginally rested upon the rim of the casing, a hopper upstanding from and supported by the flange, an unlined furnace pendent from the flange at its approximate inner periphery and stopping short of the bottom of the casing thereby defining obstructed annular and bottom spaces, a flat grate fitted into the bottom of the furnace, said grate being substantially smaller in size than said bottom thereby to confine the burning fuel substantially to the region immediately above the grate, thus providing for a substantially unconsumed fuel layer between the furnace wall and said region, injector means projected through the casing close to the flange by which to introduce a supporter of combustion, and a gas-outlet pipe located axially of the furnace and having its inlet centered within the furnace and in said region, said pipe having a fluid-cooled jacket surrounding said pipe within the producer but terminating short of its inlet end.

WILLIAM MACARTHUR TELFORD.