

**No. 680,826.**

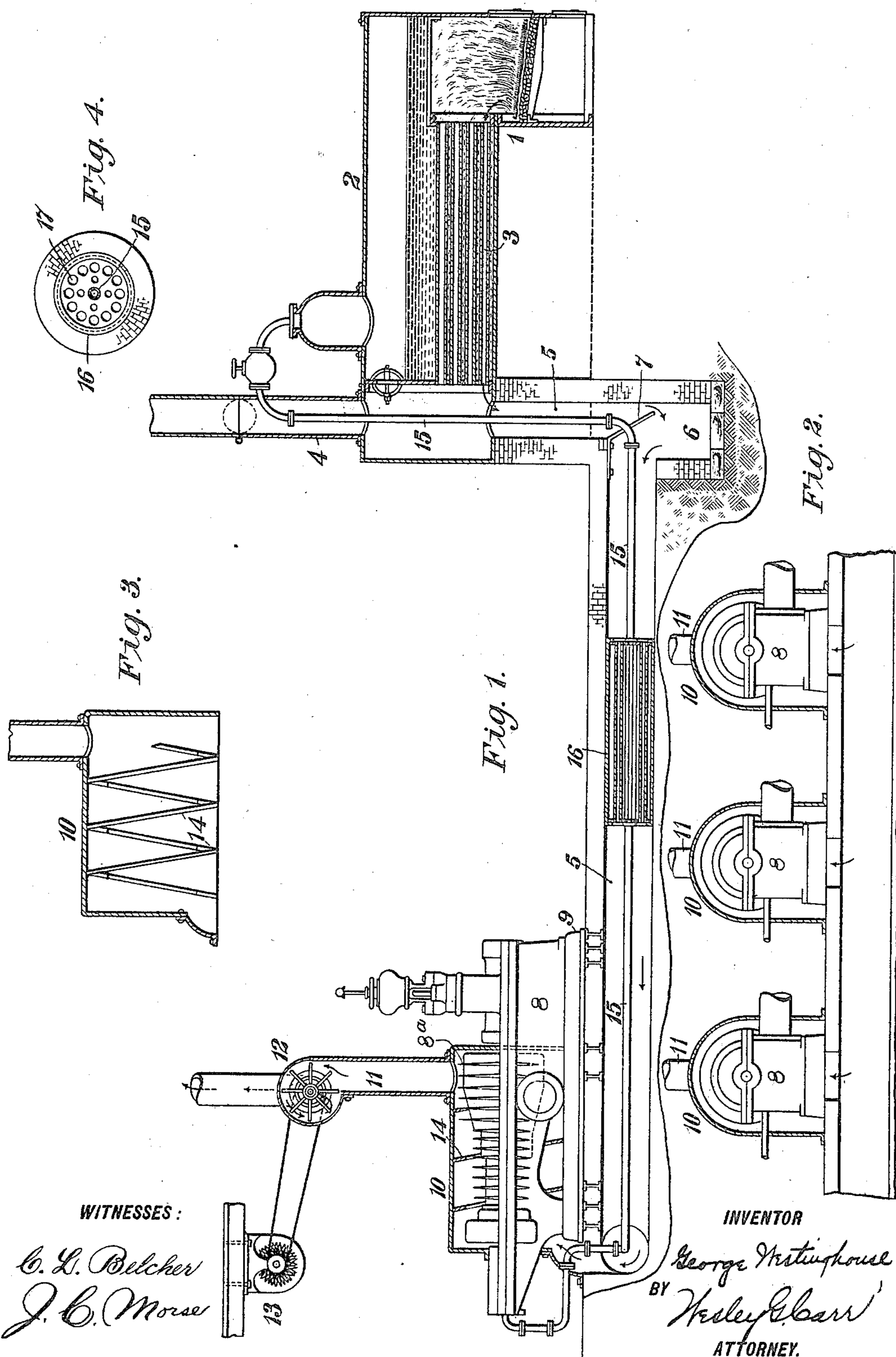
**Patented Aug. 20, 1901.**

**G. WESTINGHOUSE.**

# MEANS FOR UTILIZING GASEOUS PRODUCTS OF COMBUSTION.

(Application filed Jan. 27, 1899.)

(No Model.)



**WITNESSES :**

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# UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, OF PITTSBURG, PENNSYLVANIA.

MEANS FOR UTILIZING GASEOUS PRODUCTS OF COMBUSTION.

SPECIFICATION forming part of Letters Patent No. 680,826, dated August 20, 1901.

Application filed January 27, 1899. Serial No. 703,555. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE WESTINGHOUSE, a citizen of the United States, residing in Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Means for Utilizing Gaseous Products of Combustion, (Case No. 802,) of which the following is a specification.

My invention relates to the generation of steam and the transformation of the energy of the same into mechanical energy.

The object of my invention is to provide a means for utilizing advantageously the gaseous products of combustion that ordinarily go to waste through the smoke-stacks of boiler-furnaces.

It has been usual in steam-engineering prior to my present invention to permit the gases produced by the combustion of fuel in the boiler-furnaces to escape through the stacks, and as such gases when leaving the boiler-flues are at a very high temperature it follows that a large amount of heat goes to waste which, if utilized for the purpose of heating feed-water or for superheating the steam supplied to the engines, would result in a very considerable saving. I propose by my present invention to conduct the hot gaseous products of combustion emitted from the boiler-flues through a suitable conduit or passage so designed and constructed as to preclude any material radiation of heat to the vicinity of the steam engine or engines and there to so apply such products of combustion to the steam in the engine or engines as to maintain the steam in a superheated condition while it is doing work. I propose also to utilize these products of combustion when desired during their passage from the boiler to the steam-engine for the purpose of superheating the steam before it passes into the engine. This utilization of the heat of the products of combustion is auxiliary, however, to the main use and may or may not be employed, according to the desires of the user.

I am aware that it has been proposed prior to my invention to utilize the waste products of combustion for the purpose of heating feed-water and also for the purpose of superheating the steam; but in all such cases, so far as I am aware, the products of combustion have

been utilized at or near the boiler, and consequently the beneficial results attained by my present invention have not been possible of attainment, since the heat thus imparted to the feed-water or to the steam is to a great extent lost during the passage of the steam from the boiler to the engines.

In the accompanying drawings, Figure 1 is a view, mainly in longitudinal section, but partially in side elevation, of a plant embodying my invention. Fig. 2 is a view, partially in section and partially in end elevation, of three engines provided with means for applying gaseous products of combustion thereto. Fig. 3 is a longitudinal section of one of the steam-engine casings, and Fig. 4 is a transverse sectional view on line *xx* of Fig. 1.

The details of construction shown in the drawings are as follows, the several parts being largely diagrammatically illustrated:

The furnace 1 may be of any desired or suitable construction adapted for the burning of fuel, either solid, liquid, or gaseous, for the purpose of producing steam in the boiler 2, the gaseous products of combustion passing through the boiler-flues 3 in the well-known manner.

The products of combustion in passing through the flues 3 obviously impart to the water in the boiler a sufficient degree of heat to vaporize the same; but on account of the draft through the escape flue or stack 4 the gases pass from the ends of the boiler-flues at a very high temperature, the heat thus passing out through the stack being ordinarily a total waste. In order to utilize all or a material portion of this waste heat, I provide a flue or conduit 5, extending downward from the rear end of the boiler into the foundation and thence along horizontally to the point where the steam-engines are located. This flue or conduit 5 being surrounded by a considerable quantity of masonry, there is little possibility of loss of heat by radiation. Any known auxiliary means for lining the conduit or flue may, however, be employed in order to still further guard against heat radiation.

In order to prevent the passage through the flue of any solid products of combustion, such as cinders, I provide a well 6 below the

vertical portion of the flue 5 and interpose at the elbow a downwardly-inclined deflector 7, which sufficiently covers the end of the horizontal portion of the flue 5 to prevent the entrance therinto of cinders or other solid products of combustion.

The engine 8, mounted upon a suitable bed-plate 9, is provided with a casing 10, into one end of which the flue or conduit 5 opens. At the other end of the casing 10 is an exhaust-flue 11, in which is located an exhaust-fan 12, which may be driven by any suitable motor 13. The interior of the casing 10 may be provided with deflecting ribs or vanes 14, as shown, in order to retard the passage of the hot gases through the casing sufficiently to compel them to give up the greater portion of their heat, and the inclosed portion of the engine may be provided with ribs 8<sup>a</sup>, if desired, in order to both retard the movement of the hot gases and provide additional heat-absorbing surface.

I have shown steam-engines of the turbine variety as examples; but it will be understood that the invention is also applicable to other types of engines, it being merely necessary in any case to surround the steam-using portion by a casing in order to apply the hot gases directly to the steam as it is being utilized.

In Fig. 2 I have shown three steam-turbines 8, each of which has a casing 10; but obviously a greater or less number of engines may be employed, and the casings may be otherwise constructed and arranged. In fact, a single casing for a plurality of engines might be employed; but since the maximum degree of efficiency will be attained by locating the casing close to the steam-using portion of the engine separate casings will probably be more desirable in all cases in practice.

I have shown the pipe 15 for conducting the steam from the boiler to the engine as extending through the hot-gas flue 5, thus not only preventing heat radiation, but imparting the heat of the gases to the steam during its passage to the engine. I have also shown an auxiliary heater 16, located in the flue 5, intermediate the boiler and the engine, this heater having a considerable number of flues 17 for the passage of the gas, around which the steam is permitted to expand and circulate.

If the apparatus is properly designed and the exhaust-fan is of proper proportions and run at the right speed, the greater portion of the heat of the gaseous products of combustion will be imparted to the steam in the engine before it leaves the casing. There will necessarily, however, be some heat left in the gases, and this may be utilized, if desired, for heating water for feeding the boilers or

for any other purpose that may be found convenient or desirable.

While I have shown specific means for practicing my invention, I desire it to be understood that the details may be considerably varied without departing from the spirit and scope of my invention.

I claim as my invention—

1. A plant for producing and utilizing steam, comprising a boiler and its furnace, a steam-engine, a casing surrounding the steam-using portion of the engine and provided with deflecting-ribs, a conduit for the gaseous products of combustion leading from the furnace to the engine-casing, a steam-pipe leading from the boiler to the engine and located in said conduit and an exhaust-flue for the engine-casing provided with an exhaust-fan.

2. A plant for producing and utilizing steam comprising one or more boilers, and one or more furnaces, one or more steam-engines, the steam-using portions of which are provided with a casing or with casings having heat deflecting or retarding means, a pipe for conducting steam from the boiler or boilers to the engine or engines, and a conduit for conducting gaseous products of combustion from the furnace or furnaces to the steam-engine casing or casings, said steam-pipe extending through said conduit to the engine casing or casings.

3. In a steam producing and utilizing plant, a boiler and its furnace, a steam-engine and a casing for the steam-using portion thereof having heat-deflecting devices, a flue or conduit connecting said furnace with said casing, means for causing the gaseous products of combustion to traverse said conduit, a steam-pipe extending through said conduit between the boiler and the engine, and an auxiliary heating-drum located in said conduit.

4. In a steam producing and utilizing plant, a boiler and its furnace, a steam-engine and a casing for the steam-using portion thereof having heat-deflecting devices, a flue or conduit connecting said furnace with said casing, means for causing the gaseous products of combustion to traverse said conduit and a steam-conduit connecting the boiler with the engine and embodying a drum which is subjected to the heat of the gaseous products of combustion.

In testimony whereof I have hereunto set hand this 23d day of January, 1899.

GEO. WESTINGHOUSE.

Witnesses:

WESLEY G. CARR,  
H. C. TENER.