H. A. BRASSERT & A. G. WITTING.

METHOD AND APPARATUS FOR CLEANING GAS.

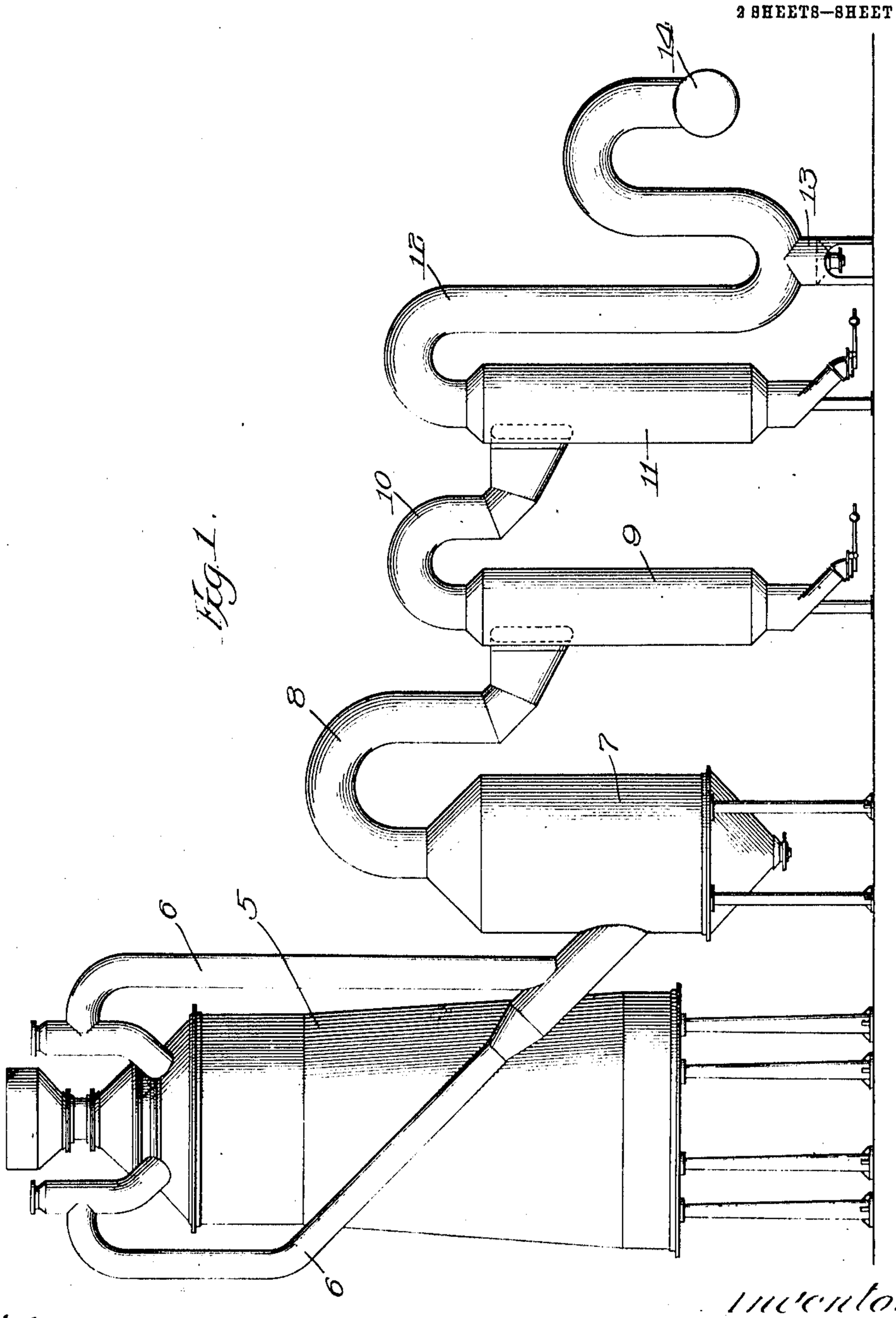
APPLICATION FILED APR. 4, 1910.

969,769.

Patented Sept. 13, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

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2 SHEETS—SHEET 2.

*Fig. 2.*

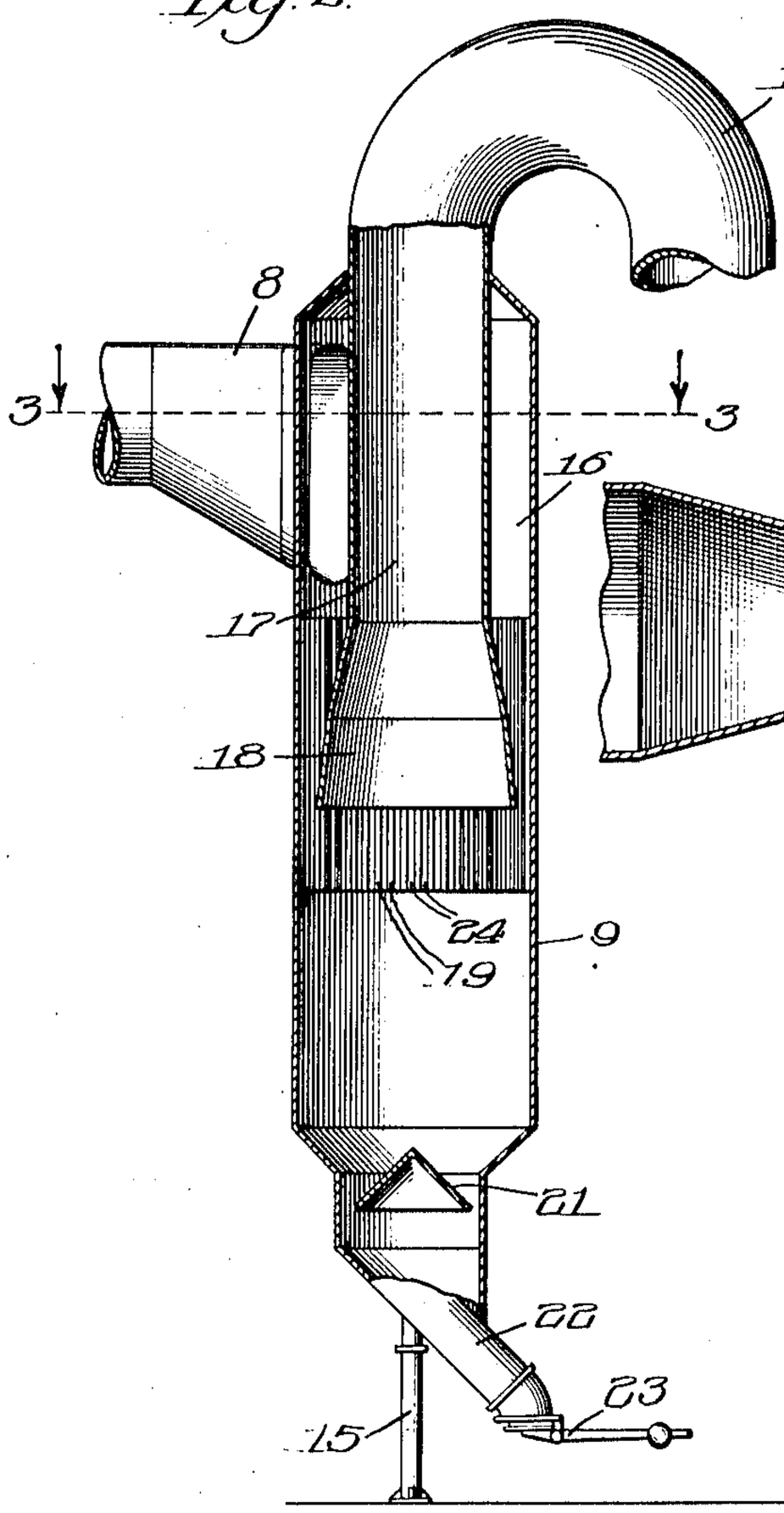
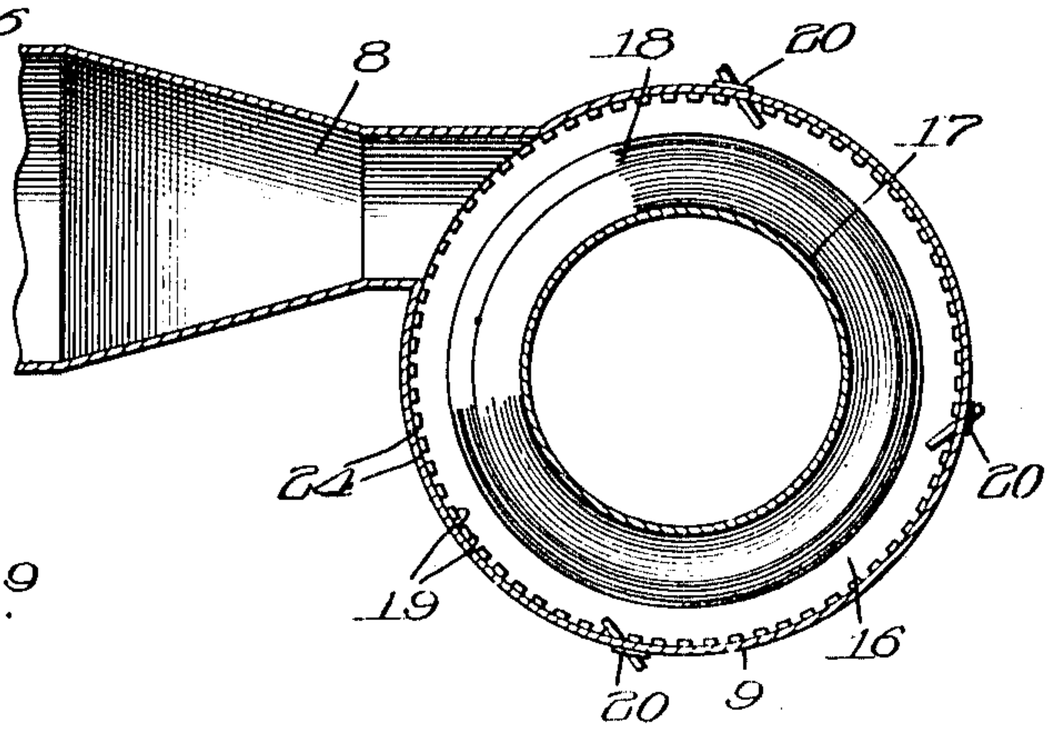



*Fig. 3.*

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# UNITED STATES PATENT OFFICE.

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## METHOD AND APPARATUS FOR CLEANING GAS.

969,769. Specification of Letters Patent. **Patented Sept. 13, 1910.**

Application filed April 4, 1910. Serial No. 553,394.

*To all whom it may concern:*

Be it known that we, HERMAN A. BRASSERT, a citizen of the United States, and ALBIN G. WITTING, a subject of the King of Sweden, both residing at Chicago, in the county of Cook and State of Illinois, have jointly invented certain new and useful Improvements in Methods and Apparatus for Cleaning Gas, of which the following is a specification.

Our invention relates to a method and apparatus for cleaning gas, and is especially useful in connection with blast furnaces for smelting iron.

During the process of smelting iron in a blast furnace a large amount of combustible gas is formed which is conducted away from the top of the furnace through a suitable downtake or downtakes and flues. This combustible gas is formed by the action of the air of the blast on the coke and ore contained within the blast furnace. It will be evident that on account of its high velocity and the fineness of some of the materials charged, this gas in passing from the top of the furnace will carry with it a considerable amount of fine dust. In order to utilize the blast furnace gas for heating the blast furnace stoves, for generating steam in boilers, for use in gas engines or other purposes, it is necessary that the dust which is carried over from the blast furnace in the gases, should be removed from the same. In order to accomplish this result it is customary to use a large dust catcher which is connected with the downtake from the blast furnace. On account of the large diameter of the dust catcher, the velocity of the gas passing through the downtake will be greatly decreased when it reaches the dust catcher, and by the action of gravity alone a large amount of dust will fall to the bottom of the dust catcher, and the gas which passes off from the top of the same will contain only comparatively fine dust. The ordinary type of dust catcher will reduce the content of solid material to 10 to 25 grains per cubic foot of gas. This content of dust is much too high to allow the most advantageous use of the gas for heating the stoves, and also for use in connection with boilers, while it renders the gas absolutely unfit for use in the gas engines.

In order to reduce the amount of fine dust in the blast furnace gas, it has been customary to pass the gas after it leaves the dust catcher through scrubbers or cleaners of various types. All of these cleaners, however, are dependent on the use of water, and the more efficient types use movable parts in order to bring the gas into thorough and close contact with the water to effect the cleaning operation.

Our type of gas cleaning apparatus is constructed on an entirely different principle from either the ordinary type of dust catcher or the gas cleaners which employ water to perform the cleaning operation.

An important object of the present invention is to effectually separate dust from blast furnace gases in an efficient, economical and rapid manner and at the same time to recover the flue dust in a dry condition.

It is a well known fact that the volume of gas produced by a blast furnace is a constantly varying quantity, and therefore it is another important object of this invention to provide for the maximum separation of the dust from the gas with respect to any volume of gas, whereby the apparatus accommodates itself to varying volumes of gas without requiring any adjustment or other manual attention.

Although it is customary to use our invention without the introduction of water into the gas, in some cases it is of advantage to introduce a spray into the gas at a certain portion of its passage through the apparatus. This water serves to cause the small dust particles to cling together and thereby become heavier. The water which is introduced in the first cleaner, when a succession of cleaners is employed, is, to a considerable extent, caught in the first cleaner and passes downwardly with the dust into the bottom of said cleaner. A certain amount of moisture either in the form of fine mist or vapor, is carried over into the second cleaner and is there removed by centrifugal action of the rotating gas and by condensation on the comparatively cool wall of the cleaner. The gas is thereby caused to leave the last dust catcher in a dry condition. We thus obtain the benefit of washing the gas and at the same time drying it, thus preventing its fuel value from being reduced.

Another very important advantage of our gas cleaner is that it is much smaller than the ordinary type of dust catcher, and when used to replace a dust catcher greatly reduces the danger of an explosion of the blast

furnace gas. These and other advantages of our invention will be more apparent by reference to the accompanying drawings which represent a preferred embodiment of our improvement and in which:

Figure 1 is a diagrammatic elevation showing a pair of our gas cleaners used in connection with the blast furnace and an ordinary dust cleaner. Fig. 2 is a vertical section through one of the gas cleaners. Fig. 3 is a transverse section on the line 3—3 of Fig. 2.

From the top of the blast furnace 5, the downtakes 6, 6 lead the blast furnace gas into the lower part of the dust catcher 7. This dust catcher is of the ordinary type, and on account of the expansion of the gas, the heavier and coarser part of the dust which is contained in the gas falls to the bottom of the dust catcher. The gas which has thus been partially cleaned passes through the flue 8 into our improved gas cleaner 9, and then through the flue 10 into the second gas cleaner 11. The gas next passes from the flue 12 past the Crawford seal 13 of well known construction, into the gas main 14 from which the stoves and boilers are supplied.

According to the system which we have just described, the dust contained in the gas may be reduced to approximately .5 grain per cubic foot. If it is desired to decrease the amount of dust still further, the gas may be passed through a centrifugal washer of the Theisen or other suitable type, which although expensive to operate is efficient in reducing the dust to a very low percentage and places the gas in a condition to be used in gas engines.

Instead of passing the blast furnace gas through a dust catcher 7, it may be led directly from the downtakes 6, 6 into the first cleaner 9 and from thence to the second cleaner 11. We have mentioned two cleaners as being used in our system but it is evident that a single cleaner could be employed, or any number could be connected together in series as indicated in Fig. 1.

Having thus described the system in which our gas cleaner is used, we will next pass to the detailed description of its parts, it being understood that the description of gas cleaner 9 applies equally to gas cleaner 11 as shown in Fig. 1.

The gas cleaner 9 is mounted on the support 15 and contains a cylindrical chamber 16. The flue 8 enters the upper part of the chamber 16 tangentially as clearly shown in Fig. 3. A large pipe 17, the upper end of which is integral with the flue 10, passes downwardly into the chamber 16 and is provided with an outwardly flaring end 18. A number of iron or steel bars 19 are fastened vertically around the chamber 16 and extend from a position well above the lower edge of the flaring end 18 of the pipe 17 to a position well below the lower edge of this pipe. We prefer to attach these bars 19 vertically, but if desired they may be placed obliquely within the chamber 16. A number of nozzles 20 directing sprays of water into the annular space between the pipe 17 and the wall of the chamber 16 may be used for a purpose which will be explained hereafter.

In the lower part of the chamber 16, is placed a cone 21 which allows the passage of dust into the outlet pipe 22. The bottom of this outlet pipe 22 is provided with the trap 23 through which the dust may be periodically removed.

The operation of our gas cleaner may now be readily understood. The gas coming into the gas cleaner tangentially through the flue 8, is given a rotary whirling motion through the annular space between the pipe 17 and the wall of the chamber 16. On coming in contact with the bars 19, the dust is caught in the channels 24 between these bars and is held in position by the combined action of centrifugal force and friction. As the gas continues to rotate within the annular space above mentioned, its velocity is gradually increased by the action of the flared end 18 of the pipe 17 until when it reaches the lower edge of the end 18, its velocity is at a maximum. On passing below this edge, the velocity is suddenly decreased, the direction of the gas is changed and it passes upwardly through the flared end 18 and pipe 17 to the flue 10. The dust which has been caught in the channels 24 drops vertically down into the bottom of the chamber 16 past the cone 21 and falls into the outlet pipe 22.

On account of the fact that the pressure of the gas is not reduced as in the case of the ordinary dust catcher of the ordinary type, the gas cleaner forms a more efficient means of condensing the moisture in the gas, and thus not only is the gas freed from its dust but passes out of the cleaner in a much drier condition than when it entered the same. On account of this drying action and also on account of the fact that the temperature of the gas is not reduced by passing through water as in the ordinary washers, the heating value of the gas passing through our cleaners is considerably higher than that of the gas passing through the ordinary types of dust catchers and washers.

When it is desired to obtain a gas which is especially free from dust, the nozzles 20 may be used for spraying water into the annular space between the pipe 17 and the wall of the chamber 16. These nozzles point in the same direction as that in which the gas is being rotated, and so not only act as a means of introducing moisture into the gas, but also act as injectors to aid the rotary

motion of the gas. As explained above, when this water is used it is to a great extent expelled from the gas by centrifugal force in the first cleaner and by combined centrifugal force and condensation in the second cleaner so that not only is a greater percentage of dust removed by causing the particles of dust to adhere to each other, but the gas passes from the second cleaner in a much drier condition than that in which it enters the first one. In order to facilitate the action of condensation either when the nozzles 20 are used or not, the outside of the gas cleaner may be water cooled if desired.

In the practice of our invention the blast furnace gas may be passed first through the ordinary type of dust catcher to remove the heavier and coarser solid material, or it may be carried directly to one of our gas cleaners.

From the foregoing description it will be understood that we depend upon the centrifugal force of the whirling gas passing through a closed conduit to throw out the relatively heavy dust particles to effect the separation of the dust from the gas. In using the term "closed conduit," we mean a conduit which is closed throughout its sides so as to prevent the escape of the gas and the separated dust, and by thus preventing the lateral escape of gas we also prevent the loss of velocity which would ensue if the gas was permitted to escape laterally from the conduit. According to our invention the conduit may be open at each end, and provision may be made for access to the conduit between its ends for removing accumulations of dust or for any other purpose.

It will be evident that many changes may be made in the detailed construction of the parts which we have mentioned without departing from the spirit of our invention.

We claim:

1. An apparatus for cleaning gases including a closed conduit, means for producing a whirling motion to the gas in the conduit, and means to prevent the velocity of the gas falling below a minimum rate, substantially as described.

2. An apparatus for cleaning gases including a closed conduit having a dust collecting surface portion, means to produce a whirling motion of the gas in the conduit and means to prevent the velocity of the gas falling below a minimum rate when passing the dust collecting surface portion, substantially as described.

3. An apparatus for cleaning gases including a closed conduit having a dust collecting surface portion, and means to produce a whirling motion of the gas in the conduit, a portion of the cross sectional area of the conduit being contracted, and said contracted portion being provided with a dust collecting surface, substantially as described.

4. An apparatus for cleaning gases including a closed conduit, means for producing a whirling motion of the gas in the conduit, and means to increase the frictional resistance offered to the material contained in the gas, substantially as described.

5. An apparatus for cleaning gases including a closed conduit, means to produce a whirling motion of the gases in the conduit, a portion of the cross sectional area of the conduit being contracted, and means for pocketing the dust throughout the contracted area, substantially as described.

6. An apparatus for cleaning gases including a closed conduit, means to produce a whirling motion of the gases in the conduit, a portion of the cross sectional area of the conduit being contracted, and means for pocketing the dust on the outer wall of the contracted area, substantially as described.

7. An apparatus for cleaning gases including a conduit, means for producing a whirling motion of the gas in the conduit, a gas outlet extending downwardly into the conduit and having a downwardly and outwardly flared open end contracting a portion of the cross sectional area of the conduit, and an annular series of longitudinal ribs upon the interior of the conduit at the contracted portion thereof, sbstantially as described.

8. The method of cleaning gas, consisting in imparting to the gas a rotary motion, maintaining a predetermined velocity of the gas, and suddenly decreasing the velocity of the gas, substantially as described.

9. The method of cleaning gas consisting in imparting to the gas a rotary motion, increasing the centrifugal force thereof, and suddenly decreasing the velocity of the gas, substantially as described.

10. The method of cleaning gas consisting in imparting to the gas a rotary motion, gradually increasing the centrifugal force thereof, and suddenly decreasing the velocity of the gas, substantially as described.

11. The method of cleaning gas consisting in imparting a rotary motion to the gas, gradually increasing the centrifugal force, suddenly decreasing the velocity, and changing the direction of the flow of the gas, substantially as described.

12. The method of cleaning gas consisting in imparting thereto a rotary motion, gradually increasing the centrifugal force, and suddenly decreasing the velocity and simultaneously changing the direction of flow of the gas, substantially as described.

13. The method of cleaning gas, consisting in imparting thereto a rotary motion,

increasing the centrifugal force, and pocketing dust separated by centrifugal action, substantially as described.

14. The method of cleaning gas consisting in imparting thereto a rotary motion, increasing the centrifugal force, and increasing the frictional resistance to the particles to be separated, substantially as described.

15. The method of cleaning gas consisting in imparting thereto a rotary motion, gradually increasing the centrifugal force, increasing the frictional resistance to the particles to be separated, and pocketing the dust separated by the centrifugal action, substantially as described.

16. The method of cleaning gas consisting in imparting thereto rotary motion, gradually increasing the centrifugal force, increasing the frictional resistance to the particles to be separated, and suddenly decreasing the velocity, substantially as described.

17. The method of cleaning gas consisting in imparting thereto rotary motion, gradually increasing the centrifugal force, increasing the frictional resistance to the particles to be separated, and suddenly decreasing the velocity and simultaneously changing the direction of flow of the gas, substantially as described.

18. The method of cleaning gas consisting in imparting thereto a rotary motion, increasing the centrifugal force, increasing the frictional resistance to the particles to be separated, pocketing the dust separated by centrifugal action and suddenly decreasing the velocity and simultaneously changing the direction of flow of the gas, substantially as described.

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