Jan. 14, 1930. C. G. HAWLEY 1,743,344

GAS CLEANER

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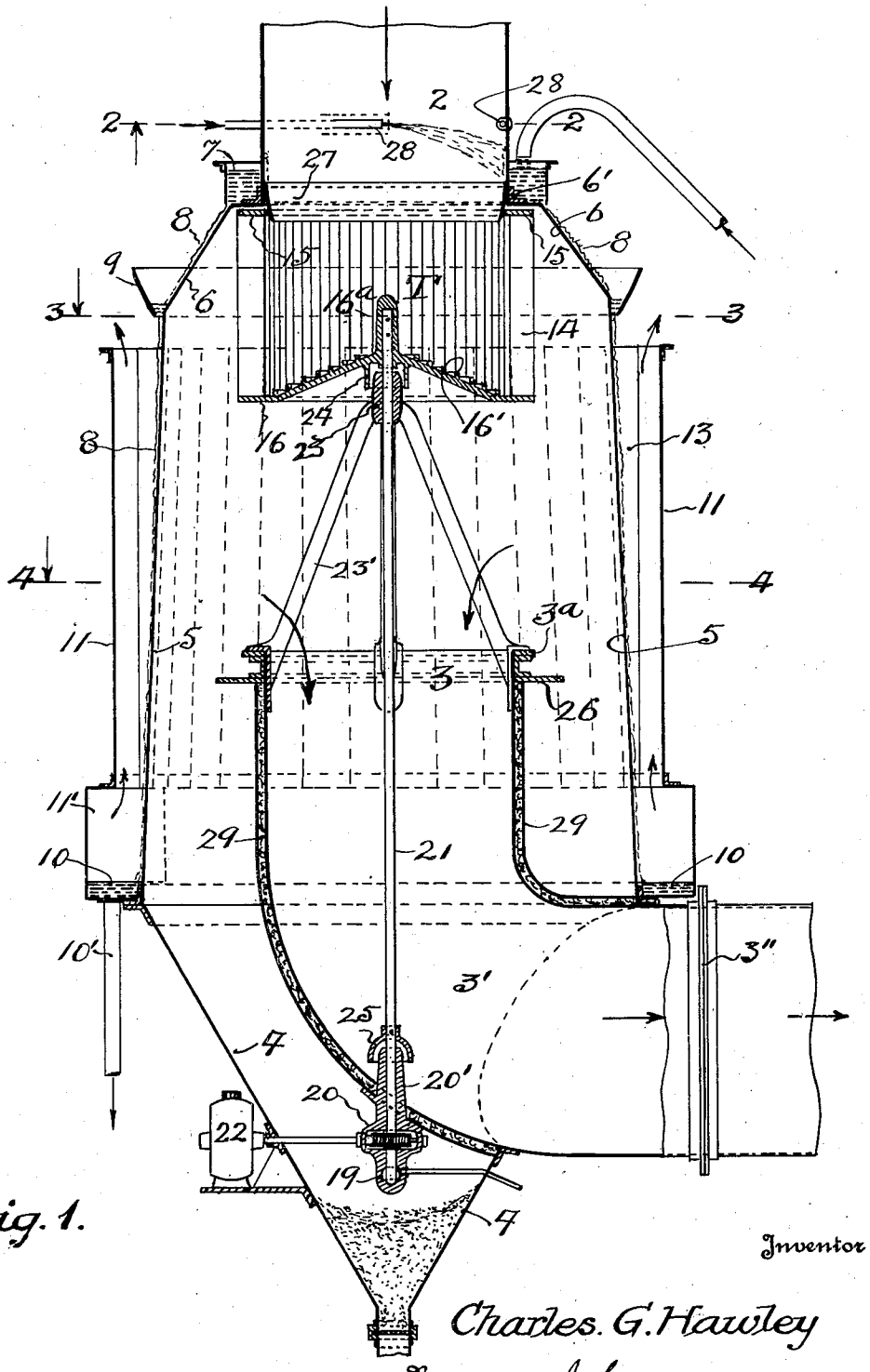


Fig. 1.

Inventor

Charles. G. Hawley

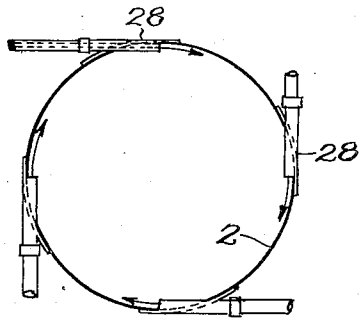
By C. A. Mason Attorney

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Fig. 2.



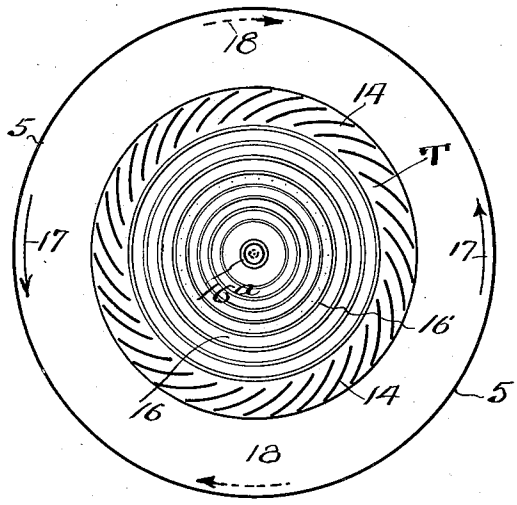


Fig. 3.

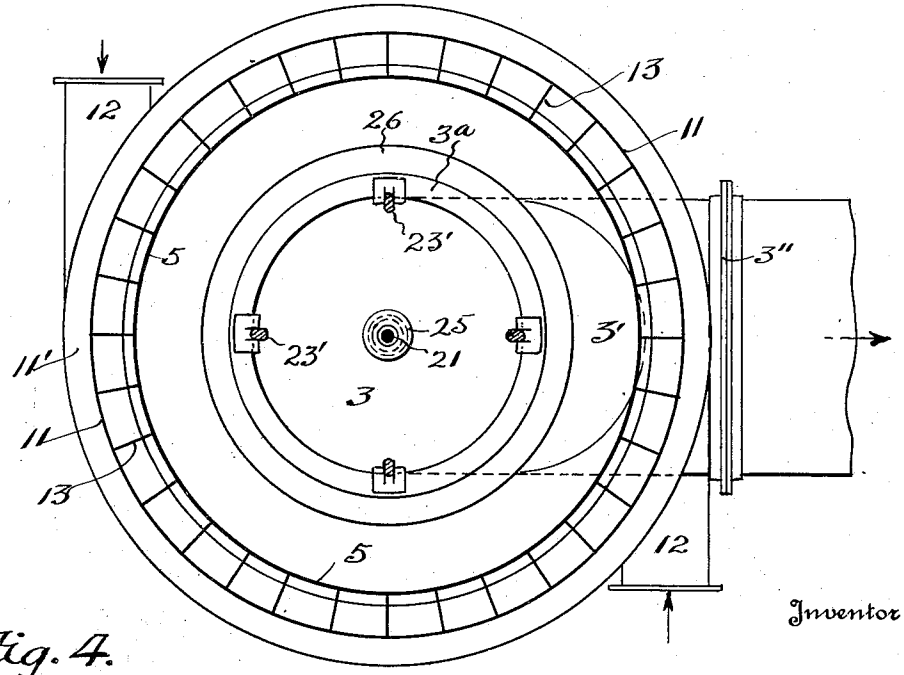


Fig. 4.

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Patented Jan. 14, 1930 1,743,344

UNITED STATES PATENT OFFICE

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GAS CLEANER

Application filed March 10, 1926. Serial No. 93,797.

My invention relates to apparatus for freeing gas and air from impurities and has particular reference to the improvement of blast furnace and producer gas cleaners; also warm and hot air cleaners.

The cleaning of blast furnace gases of some stack gases and of hot dusty air doubtless present the greatest number of difficulties to be surmounted and as my invention is adapted for successful use even with such gases, the following description will be especially directed thereto.

The further objects and the several elements of my invention and the novel process involved fully appear hereinafter and will be readily understood on reference to the accompanying drawings. In said drawings, Fig. 1 is a vertical section of a gas cleaner of the downgoer type embodying my invention; Fig. 2 is a horizontal section looking upward from the line 2—2 of Fig. 1; Fig. 3 is a horizontal section looking downward from the line 3—3 of Fig. 1; and Fig. 4 is a similar section on the line 4—4 of Fig. 1.

As just stated, the apparatus here disclosed is of the downgoer type. Immediately it is to be understood that the chief feature of my invention and the hereindescribed process of self aided separation are available for employment in gas cleaners of both the upgoer and the horizontal types. All are broadly claimed herein; certain related designs thereof are specifically disclosed in my companion application S. N. 94,083, of even date herewith.

In the drawings 2 represents the downgoer inlet and 3 the gas outlet. These are in axial alinement and are widely separated. The outlet is continued downward in the elbow 3′ which terminates in the flange 3″. Beginning at the inlet and extending downward and around and below the outlet 3 is a substantially cylindrical casing the bottom of which is formed into a hopper 4. As shown the elbow 3′ extends preferably through one wall of the hopper 4; and the outlet opening 3 is positioned well above the hopper. The body 5 of the casing is preferably somewhat larger at the bottom than at the top. It has a cover plate 6, of generally conical form that is attached to the lower end of the gas pipe 2 at the flange 6′. The top of the casing may be flat but for convenience in the distribution and retention of the external cooling water, hereinafter explained, the top 6 is best made conical.

Conveniently a circular water trough or reservoir 7 is provided at the top of the casing in position to supply and maintain a substantially uniform spray or film of water that flows downward upon the outside of the casing, as indicated by the irregular lines 8 thereon. It will be understood that the trough here shown is merely a convenient form of water sprayer and may be replaced by other devices. The part 9 is a splice ring that is supported at the top of the casing and spaced away from the outer surface thereof to assist in controlling the flow of water from the superposed spray head or trough. At the bottom the water is caught in the annular trough 10 and is disposed of through the drain pipe 10′.

The part 11 is a jacket spaced away from the body of the casing and through which air may be blown or drawn to assist the water in cooling the jacket for the purpose hereinafter explained. Or the use of water may be disregarded and air alone used as the cooling agent. Conveniently, the trough 10 is formed into an air distributing ring or box 11′ at the lower end of the casing and the air is delivered thereto through preferably tangential inlets 12, as shown in Fig. 4. To ensure a maximum of heat radiation from the casing it may be provided with a large number of radiating fins 13.

The jacket and fins need not be used where there is an abundance of cooling water available. Indeed the absorption of heat from the casing is sufficiently taken care of, in some cases, by merely exposing the casing to the external cold air unaided by either water spray or air blast.

The member T is a whirl promoting or producing tuyère which is suspended or otherwise supported directly beneath and in open communication with the downcomer gas pipe 2. The member T herein shown comprises a large number of tangentially positioned

blades 14, which are held at the top by a ring 15 and at the bottom rest upon the margin of the plate or closure 16. The latter receives the direct impact from the descending gases and by preference it is a tough casting, manganese steel or the like, and is in the form of a low pitched cone which has a plurality of annular projections or rings 16′ on its top. The latter fill with dust which serves to protect the plates 16 from wear.

If the tuyère T be used as a fan or blower and rotated accordingly, the gases flowing down through the same are subjected to vigorous rotation within the casing, in the direction indicated by the arrows 17 of Fig. 3. On the other hand, if the tuyère T is held stationary, the same in itself serves to direct and set the gases into vigorous rotation in a direction indicated by the dotted arrows 18 of Fig. 3. Either direction of rotation is suitable so far as the other parts of the gas cleaner are concerned and the user is left to his choice but should understand that the member T when used as a fan requires the expenditure of some little power for its rotation and, further, that because of unequal wear the member T may rather quickly get out of balance and to that extent require maintenance attention. By securely hanging or locking the member T in place and against rotation the same rotative effect upon the gas is secured at an expense of very little resistance to the gas flow and without the expenditure of external power; further, the effects of wear or abrasion by the particles carried by the gas are less noticeable. However, as some will desire to use a tuyere which rotates, I have herein shown what I regard as the best means for its support and rotation.

The means just referred to comprise a central shaft 21 which rises through the clear gas space within the casing. The lower end of the shaft is provided with a tightly enclosed step bearing 19 which preferably hangs from the lower side of the elbow 3′. The step casting also encloses the gearing 20 through the medium of which the shaft 21 is rotated from the motor 22 that is supported on the hopper bottom 4. The tuyère bottom 16 has a hub 16ª which is rigidly fastened to the upper end of the shaft 21. Thus both shaft and tuyère are supported by the step bearing 19. The necessary second bearing 23 is arranged directly in the clear gas space close beneath the tuyère bottom 16 and is supported by arms 23′ that extend upward from the flange or margin 3ª of the gas outlet 3. The gas having been cleaned before it reaches the axial portion of the casing, it should be apparent that the parts 23, 23′, 21 and 20, suffer little wear and are of a substantially permanent character. Precautionary dust shields or collars 24 and 25 are provided at the upper ends of the bearing 23 and 20′ respectively.

The member 26 is a wide flange or collar positioned below the flange 3ª and serving to defeat the vortexial return of dust that has been thrown to the bottom of the casing, as hereafter explained.

The part 27 at the lower end of the gas pipe 2 is a guard collar which bridges the gap between the lower end of that pipe and the top or ring 15 of the tuyère T. The ring 27 may be dispensed with and the ring 15 is attached directly to the top of the casing, that is, when the tuyère is to be used as a stationary, non-rotative member.

At times, and perhaps at all times, it is desirable to add moisture to the gases and I provide novel means to that end. Said means comprise the tangential water jet pipes or nozzle 28 which are fixed in and project into the gas pipe 2. In each case a slot is cut in the pipe 2 and the pipe laid in the slot. As best shown in Fig. 2 each pipe is formed by a casting that has a flange which covers the slot in the pipe and serves as a convenient means of attachment. One or more of these jet pipes may be used at the lower end of the pipe 2 and if desired also at the top of the main casing.

As about to be explained, the gas to be cleaned is hot, hot enough to form its contents of water into steam and at no time is enough water used from the spray pipe to so lower the temperature of the gas as to avoid the evaporation of any water that may chance to belong suspended therein. Anticipating the full disclosure of my novel process, it may here be mentioned that the water involved instead of being permitted to pass into suspension is carefully retained upon the externally cooled walls of the described casing and is thus kept in the form of water, at least until the dust has been delivered to the hopper 4. Generally, the hopper need not be externally cooled, except as it is exposed to the external atmosphere; and to keep the temperature in the hopper as low as possible without a further supply of cooling water, I prefer to cover the elbow 3 with an insulating lining or insulating material 29, as well shown in Fig. 1. Further, this lining aids in retaining the heat of the gases which have been cleaned. The latter is one of the chief aims of my invention.

The gas which enters the casing through the inlet 2 and the tuyere T contains usually a high percentage of moisture in the form of superheated steam. That is, the gas is usually at a temperature exceeding 212° F. and contains so large an excess of heat as to superheat the steam. The tuyère, whether it be rotated or stationary serves to project the dust laden gases into rotation and against the opposed wall of the casing; thereby the centrifugal separation of the dust is brought about and coincidently the moisture laden gas is caused to impact against the walls

which are capable of absorbing the heat of the gases and steam, thus thrown into contact therewith. In this manner considerable steam is condensed on the inner walls with the result that the inner surface of the casing is kept covered with a film of moisture. And importantly the film of moisture receives and serves to retain even the most minute dust particles.

When the described condensation of moisture is sufficient to serve this purpose continuously and establish a film that falls slowly in the hopper 4, no supplementary water is required from the jets 28. But in event the gas at the outlet begins to show a residue of dust, the jets may be turned on to ensure the uniform wetting of the internal surfaces of the casing. Indeed a small amount of water may be continually admitted through one or more jets, thus positioned at the top of the casing for the purpose of establishing a proper margin of safety in the matter of retaining the dust that is centrifugally separated against the aforesaid surfaces.

The gas that is set in rotation by the tuyère being constantly displaced at the top, naturally whirls towards the bottom of the casing and sweeping its walls aids in the positive delivery of the separated cases to the hopper 4 or other receiving space. There is little, if any, actual flow of gas in that part of the hopper which is below the flanges 3ª and 26 at the top of the elbow, instead the gas which has been freed from dust against the casing is displaced inwardly, toward the axis of the casing and thus reaches the outlet 3. To ensure the quiet movement of the gas at that time, the gap or space between the bottom of the tuyère and the outlet 3 is made very much larger than necessary for the accommodation of a stream of a size defined by the inlet 2. Thereby possible remixing effects are avoided and the dust is left in whirling condition along with the moisture on the wall of the casing.

By far the better way in which to operate this apparatus is by condensing the dust retentive moisture on the inner surface of the casing or by supplying the same through the described jets or equivalent means, but nevertheless it is to be understood that my invention comprehends the employment of the dust catcher without such aids, that is in a completely dry process.

Further various other modifications of my invention and different embodiments thereof will readily suggest themselves to those skilled in the art. Therefore my invention as to both scope and essential details is to be interpreted and ascertained from the appended claims as read in the light of the foregoing and is not to be construed as limited to the specific structures herein shown and described.

Having thus described my invention I claim as new and desire to secure by Letters-Patent:

1. The hereindescribed dust collector adapted for cleaning gases which contain condensible vapors, comprising a vertical casing having a hopper bottom and joined by an inlet pipe at the top, in combination with an outlet centrally positioned within said casing far below said inlet, a pipe leading outward from said outlet, a whirl promoting tuyère positioned at the top of said casing in communication with said inlet, and means for externally cooling the walls of said casing to the extent required to condense the vapors which impact the inner surface of said casing.

2. The hereindescribed dust collector, comprising a vertical casing having a bottom dust cavity and joined by an inlet pipe at the top, in combination with an outlet centrally positioned within said casing far below said inlet, a pipe leading outward from said outlet, a whirl promoting tuyère positioned at the top of said casing in communication with said inlet, and means for coating the external surface of said casing with liquid.

3. The hereindescribed dust collector adapted for cleaning gases which contain condensible vapors, comprising a vertical casing having a bottom dust cavity and joined by an inlet pipe at the top, in combination with an outlet centrally positioned within said casing far below said inlet, a pipe leading outward from said outlet, a whirl promoting tuyère positioned at the top of said casing in communication with said inlet, and means for air cooling the external surface of said casing to the extent required to condense the hot vapors which impact the inner surface of the casing.

4. The hereindescribed dust collector adapted for cleaning gases which contain condensible vapors, comprising a vertical casing having a bottom dust cavity and joined by an inlet pipe at the top, in combination with an outlet centrally positioned within said casing far below said inlet, a pipe leading outward from said outlet, a whirl promoting tuyère positioned at the top of said casing in communication with said inlet, and means for both water and air cooling the external surface of said casing to the extent required to condense the hot vapors which impact the inner surface of the casing.

5. The hereindescribed dust collector, comprising a casing having a dust cavity at the bottom and joined by a hot gas pipe at the top, in combination with an outlet positioned within said casing above said cavity, a hot gas pipe leading from said outlet, a whirl promoting tuyère positioned far above said outlet, within said casing and receiving the hot gas from said inlet, means for spreading water upon the internal surfaces of said tuyère to maintain a moisture film thereon, and means for externally cooling said casing

to prevent the evaporation of said film by the heat of the hot gas and to condense the hot vapors which impact the inner surface of the casing.

In testimony whereof I have hertunto set my hand this 9th day of March, A. D. 1926.

CHARLES GILBERT HAWLEY.