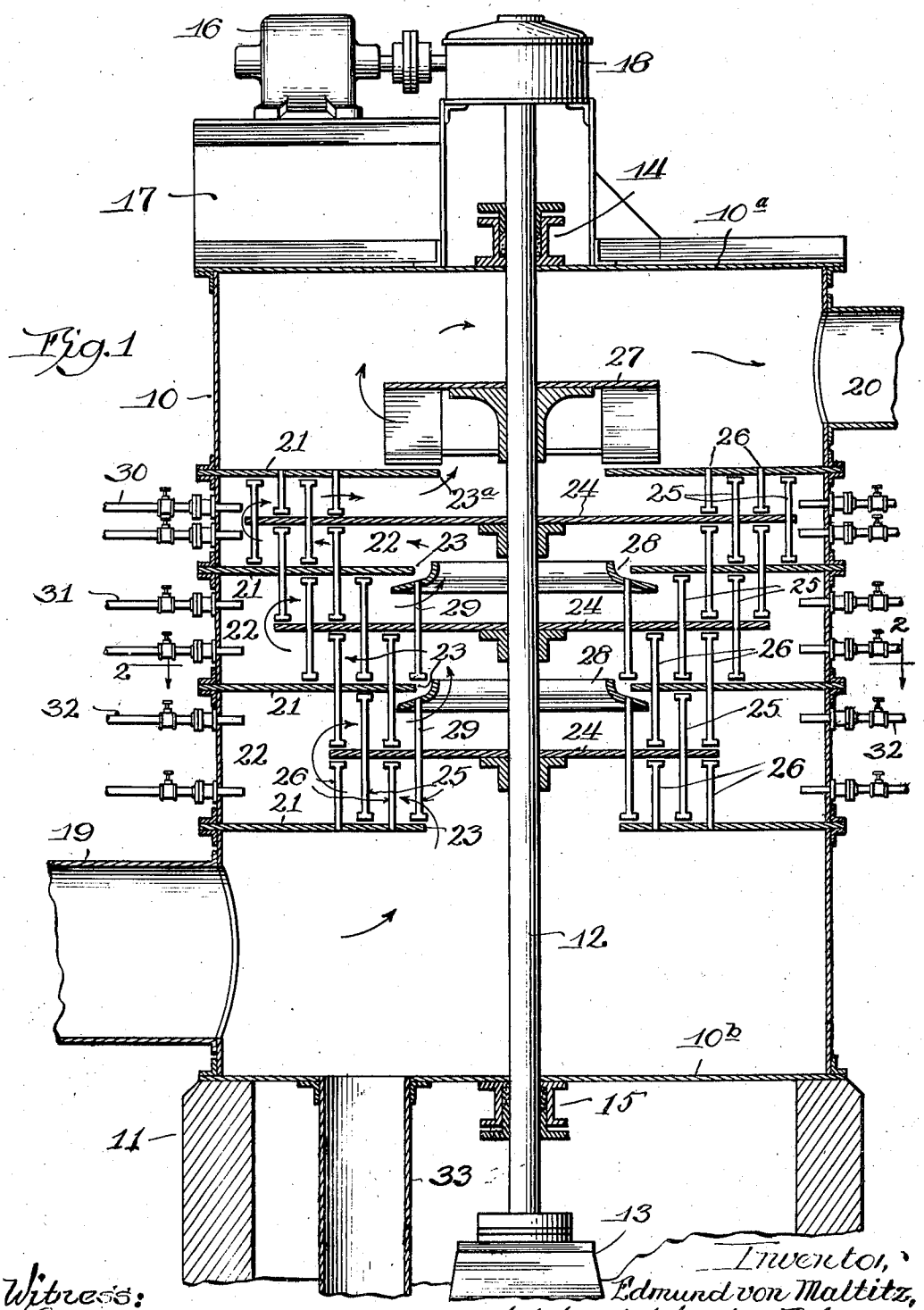
June 24, 1930. E. VON MALTITZ 1,767,628

GAS WASHING APPARATUS

Filed Feb. 7, 1927 4 Sheets-Sheet 1

Fig. 1



Witness:
Chas. L. Lourish.

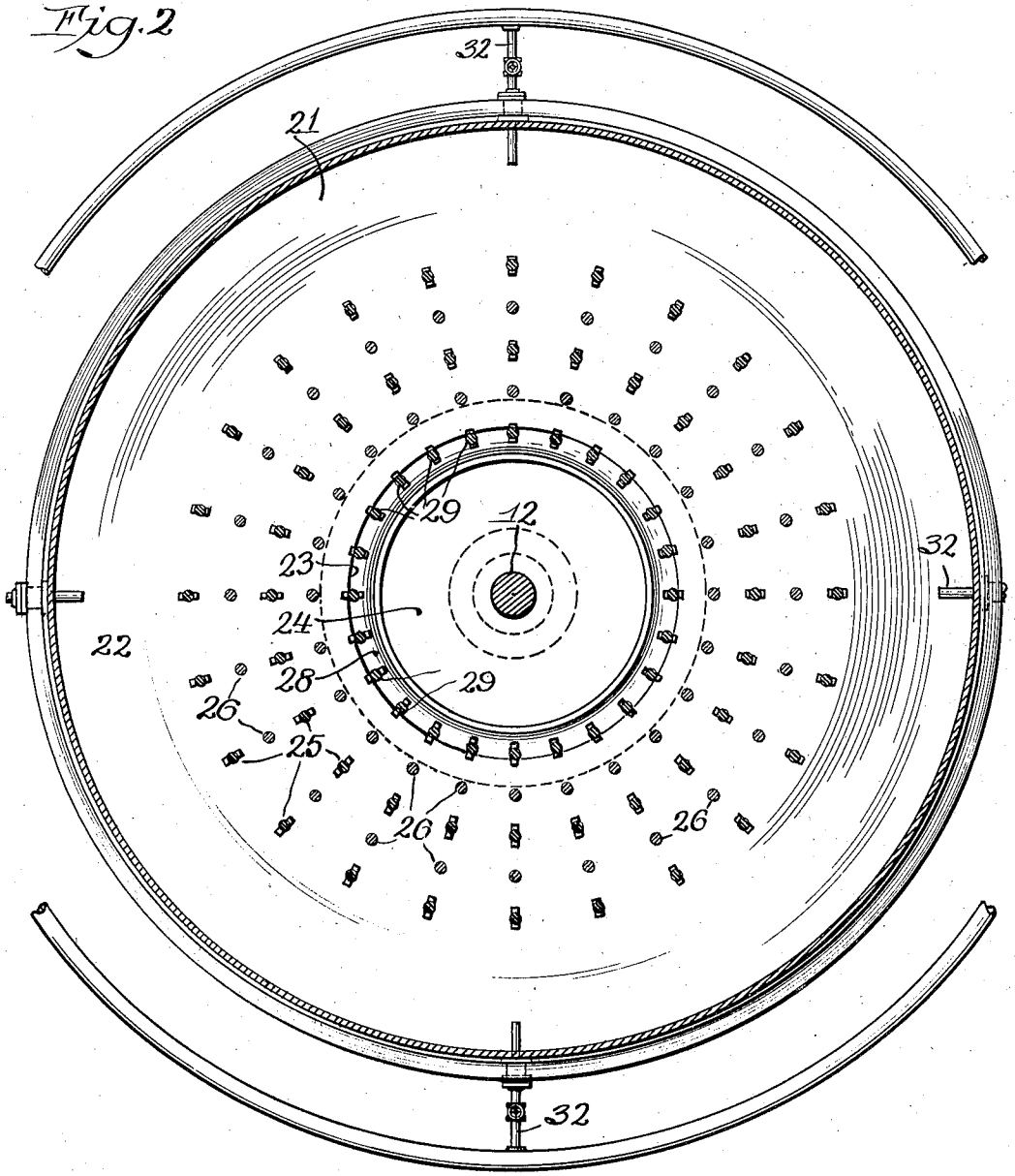
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GAS WASHING APPARATUS

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Fig. 2



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GAS WASHING APPARATUS

Filed Feb. 7, 1927 4 Sheets-Sheet 3

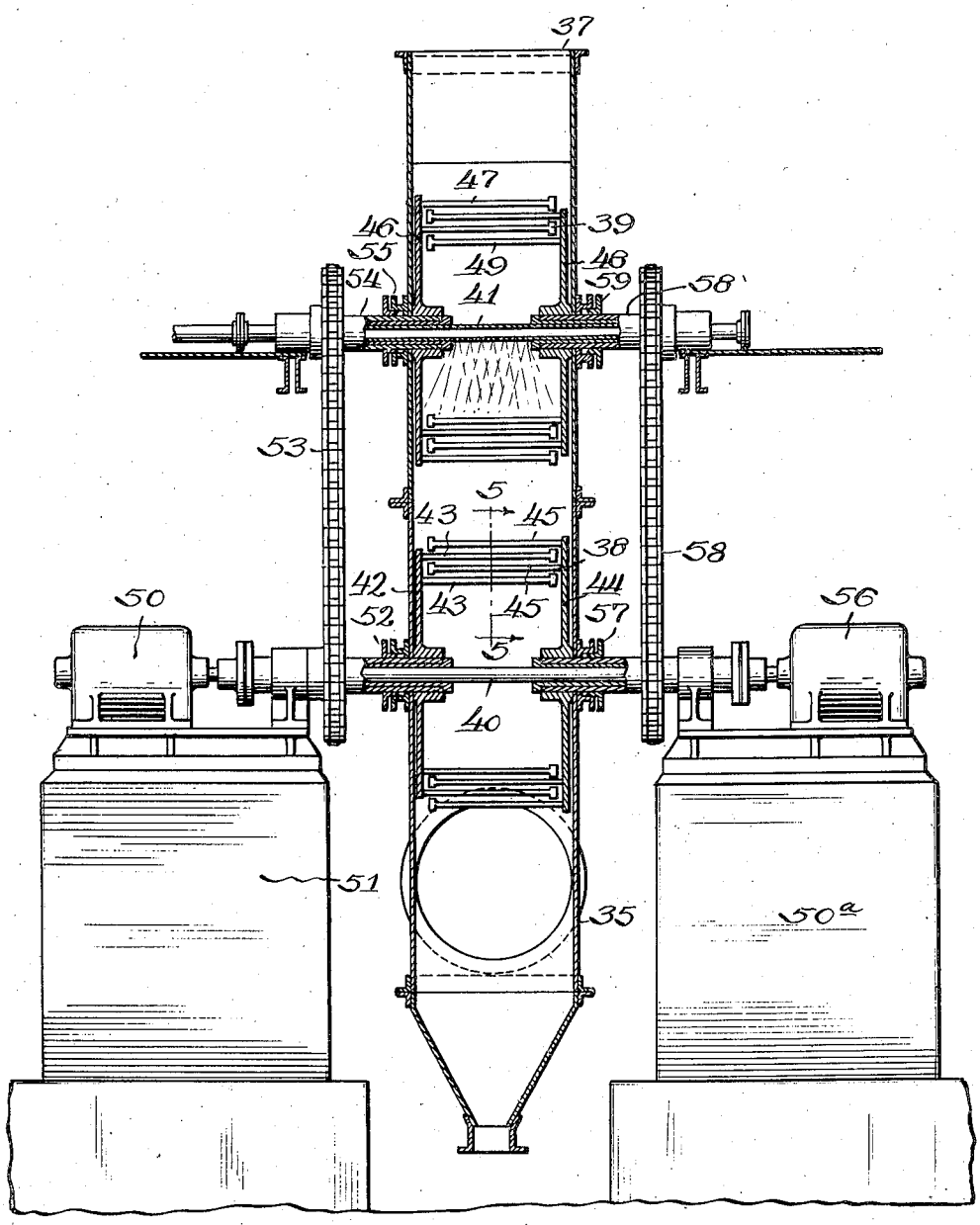


Fig. 3

Witness:
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GAS WASHING APPARATUS

Filed Feb. 7, 1927 4 Sheets-Sheet 4

Fig. 4

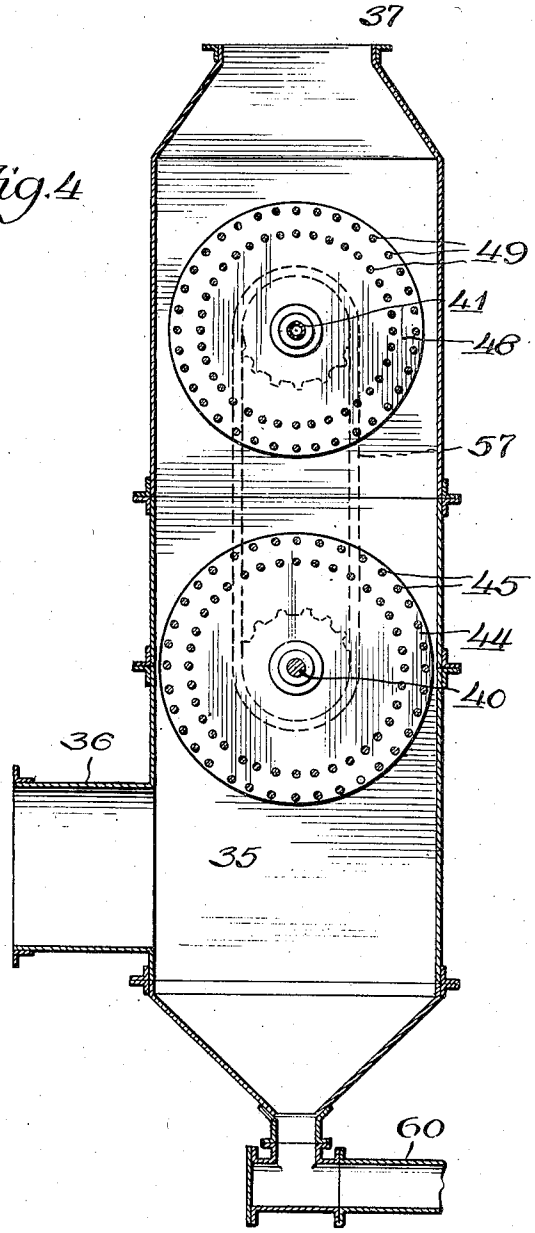
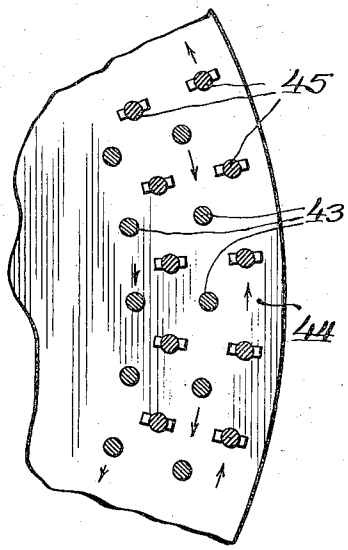


Fig. 5



Witness:
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Patented June 24, 1930

1,767,628

UNITED STATES PATENT OFFICE

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GAS-WASHING APPARATUS

Application filed February 7, 1927. Serial No. 166,348.

This invention relates to a novel and improved apparatus for mechanically washing gas and consists of the matters hereinafter described and more particularly pointed out in the appended claims.

Two generally well known methods are now employed for mechanically washing and cooling gas. In one, known as the disintegrator method, the gas is washed by passing it with the washing fluid, generally water, through and between relatively, oppositely revolving grids or paddles by means of which the gas and washing fluid are beaten together, the washing fluid being atomized into a fine spray or mist which is thoroughly beaten into and intermixed with the gas. This treatment thoroughly wets and drenches even the finest particles of dust content, which then will settle out by gravity, leaving the gas clear of such solid matter when it leaves the apparatus. In the other washing method the gas is introduced at the bottom of a vertical casing and the washing fluid is introduced at the top of the same. The washing fluid is discharged upon rotary trays or other carrying members mounted on a vertical shaft centrally disposed within the casing and rotated at such a speed as to discharge the water under the action of centrifugal force towards the periphery of the casing. The gas is forced through the sheets of water thus thrown off the trays and the dust particles carried by the gas are thoroughly wetted and drenched and by reason of their increase in weight when wet are thrown out and separated from the gas stream.

The second mentioned method has the advantage that the washing action is performed in superimposed steps or stages, with the gas going in one direction and the water in the opposite direction. The cold, clean water entering at the top of the casing acts upon the gas which has been cooled and has been partially cleaned in its upward passage through the lower part of the casing. The first mentioned, disintegrator method on the other hand, has the advantage that the washing process may be carried on in apparatus occupying a comparatively smaller space with a comparatively smaller quantity of water and in less time.

The object of the present invention is to produce an apparatus for mechanically washing gas in which are combined both the advantages of the method employed in the horizontal, disintegrator gas washing devices and of the method employed in the vertical, centrifugal gas washing devices, without the disadvantages of either, so that the gas will be washed and cooled (in the case of hot gas) with less water per unit of gas than is required in the commonly used types of horizontal disintegrator and with less vertical height of apparatus for the same performance than in the case of the well known vertical washers operating on the centrifugal principle.

The many advantages of the invention will appear more clearly as I proceed with my specification.

In the drawings:—

Figure 1 is a view representing a vertical central section through a form of apparatus embodying my improvements for mechanically washing gases.

Figure 2 is a horizontal section through the apparatus in a plane indicated by the line 2—2 of Figure 1.

Figure 3 is a view representing in vertical central section a modified form of the apparatus.

Figure 4 is a view representing a vertical section of the apparatus shown in Figure 3 in a plane at right angles to the plane of the section shown in Figure 3.

Figure 5 is a detail sectional view in a plane indicated by the line 5—5 of Figure 3.

Referring now to that embodiment of the invention shown in the drawings and more specifically in Figures 1 and 2 thereof;—10 indicates a vertical cylindrical casing erected on a hollow masonry or other base 11 and enclosed by top and bottom head plates 10^a, 10^b. Centrally disposed within this casing is a vertical shaft 12 mounted on a bottom end thrust bearing 13 and engaged with suitable aligning bearings 14 and 15 secured to the top and bottom head plates 10^a, 10^b, respectively. A motor 16 on a structural beam 17

at the top of the casing 10 is connected through gearing in a casing 18 to drive the vertical shaft 12.

A gas inlet pipe or conduit 19 is connected to the bottom of the casing and a gas outlet pipe or conduit 20 is connected to the top of the casing,—preferably at a point diametrically opposite the inlet pipe 19. Intermediate the levels of the two said conduits are provided horizontal diaphragms or partition walls 21 attached in any suitable manner to the casing and dividing the casing vertically into horizontal chambers 22, which, as shown, are of successively diminishing vertical dimensions. As illustrated there are three such chambers 22, although as will be understood, the number may be greater or less than shown as desired. The several diaphragms or partition walls 21 have central apertures or openings 23 which are greater in diameter than the diameter of the shaft 12 and the topmost of which 23^a is of less diameter than the diameter of those below.

On the shaft 12 intermediate the several diaphragms 21 are fixed discs 24, each of which is located midway vertically between the diaphragms 21 above and below it. The several discs 24, as shown, extend in vertical succession to greater distances from the center of the shaft 12,—the topmost approaching closely to the wall of the cylinder or shell 10 and the bottommost being spaced a considerable distance within said cylinder or shell. Radially spaced, vertical disintegrator members 25 are fixed in annular rows on the discs 24 and like annular rows of disintegrator members 26 are fixed on the diaphragms 21 in alternate radial arrangement with the disintegrator members 25. The said two sets of disintegrator members are relatively spaced in close relation so that the two sets, namely the movable set 25 and the fixed set 26, will operate in relatively movable, close relation, when the shaft 12 is rotated. The ends of the disintegrator members 26 carried by the diaphragms 21 extend into close relation to the discs 24 and the ends of the disintegrator members 25 carried by the rotary discs 24 extend into close relation to the diaphragms 21. The several sets of disintegrator members in the chambers 22 are approached more closely to the wall of the casing or shell 10 in the several chambers in succession vertically,—those in the bottom chamber being more remote from said cylinder or casing wall and those in the top chamber being more nearly approached to said cylinder or casing wall.

A fan 27 is fixed to the shaft 12 above the top diaphragm 21 and shallow, hollow, conical deflectors 28 are attached to the lower discs 24 in the planes of the intermediate diaphragms 21 by means of vertical rods or disintegrator members 29.

By this construction the gas drawn in at the gas inlet conduit 19 by means of the fan 27 follows a tortuous path indicated by the arrows,—first towards the shaft 12; then outwardly above the bottommost disc 24 towards the casing; then back towards the shaft and through the lower deflector 28; thence outwardly towards the casing below the disc 24 next above the bottom one; then back above said disc towards the shaft and through the next deflector 28; then outwardly towards the casing below the topmost disc 24 and then back towards the shaft and up through the opening 23^a in the topmost diaphragm and through the fan whence it proceeds through the outlet conduit 20.

Water may be introduced into the casing through spray discharge pipes 30, 31, 32 arranged in pairs, one for each chamber 22, and located so that they will discharge the water in each chamber in planes respectively above and below the disc 24 operating in that chamber. These pipes are arranged at a plurality of points about the casing and as shown, are placed at four points diametrically opposed in pairs about the casing.

The operation of the apparatus is as follows. The shaft is rotated at a suitable speed, generally from two hundred and fifty to five hundred revolutions a minute, depending upon the diameter of the casing 10,—slower speeds being used with apparatus in which the casing 10 is of larger diameter and higher speeds being used with apparatus in which said casing is of smaller diameter. Water is turned into the water spray pipes 30 which discharge into the top compartment 22 and gas is admitted through the conduit 19. If desired some water may also be admitted through the spray pipes entering the lower compartments although the best water economy is obtained by admitting all of the water through the spray pipes directed into the topmost compartment, since then only the upper compartment receives fresh water. The water in the top compartment 22 flows over the bottom diaphragm 21 thereof towards the deflector 28 located at the central aperture therein and said deflector by centrifugal force throws it through the next lower compartment 22 out towards the casing wall. Thence it falls on the bottom diaphragm 21 thereof from which it flows through the central aperture therein to the associated deflector 28, from which it is again thrown by centrifugal force towards the outer wall of the casing. Thence it falls upon the bottom diaphragm 21, whence it flows through its central aperture into the bottom of the casing 10 from which it is discharged through a waste pipe 33 connected to the bottom wall 10^b of the casing.

The water and gas thus flow in a staggered or tortuous path in opposite directions, first towards the shaft and then towards the casing wall. During this flow the oppositely

flowing gas and water pass through and between the relatively oppositely revolving disintegrator members 25 and 26 by means of which the gas and water are broken up, thoroughly mixed and scrubbed. This scrubbing process is carried on in successive stages, one for each compartment 22 and by reason of the tortuous path of the gas and water moving in opposite directions and the repeated changes of direction, propelled as they are centrifugally in opposite directions outward and inward, every part of the gas is repeatedly brought into contact with the disintegrating elements and with the water. A most effective means of washing the gas is thus brought about.

It will be noted that in this operation the clean, fresh, cold water comes into contact with gas which has been subjected to the washing and cooling action of water in the lower compartments, while the hot, dirty gas is subjected to the action of water which has been heated in its passage through the upper compartments. Thus the warmer gas meeting the warmer water and the coldest gas coming into contact with the coldest water, a most efficient heat exchange occurs.

Since the body or column of gas passing through the casing and the several compartments 22 thereof, is gradually cooled during that passage, the said several compartments are preferably diminished successively in vertical dimensions, as hereinbefore described, in accordance with the progressive contraction of the transverse section of the gas column, due to such cooling. For the same reason, the outlet conduit is made, as shown, of less diameter than the inlet conduit.

Again, when first entering the apparatus, as when entering the lower compartment 22, the gas contains the heavier particles of dust or other solid matter and only the lighter particles of such matter remain in the gas as it proceeds upwardly and passes through the upper compartments 22. For this reason the disintegrator members 25 and 26 in the bottom compartment 22 are disposed nearer the shaft 12 while those in the upper compartments are at greater and greater distances from the shaft as hereinbefore described, since the heavier particles may be thrown out by centrifugal force at a slower speed than the lighter particles which require a higher speed.

I have found that the improved washer herein described will require less water per unit of gas for cleaning and cooling purposes than the commonly used types of horizontal disintegrator and will require less vertical height for the same performance than the well known vertical washers which use the centrifugal principle of wet scrubbing.

In Figures 3, 4 and 5 inclusive, is shown a somewhat modified form of the invention. In this case I provide a vertical casing 35 as before, with an inlet conduit 36 at the bottom of the casing and an outlet 37 at the top of the casing.

Instead of a vertical shaft carrying the revolving disintegrator members and of the fixed diaphragms carrying fixed disintegrator members as in the first case, in the modification now to be described I provide two sets of oppositely revolving disintegrator members mounted on vertically spaced horizontal shafts and so arranged and operated that the space between the two sets of disintegrators, the spaces at the peripheries of said two sets of disintegrators and the spaces within said disintegrators will provide the several stages of successive treatment of the gas and water provided in the first case by the compartments formed by the fixed diaphragms therein.

38 indicates the lower set of disintegrator members and 39 indicates the upper set. 40 indicates a horizontal shaft on which the lower set of disintegrators is mounted and 41 a shaft on which the upper set is mounted. As shown, the bottom set of disintegrator members 38 comprises a disc 42 carrying near its periphery radially spaced horizontal disintegrator members 43, 43 and a disc member 44 carrying at its periphery horizontally disposed radially spaced disentegrator members 45 which extend between the disintegrator members 43 on the other disc 42. The other set comprises a like disc 46 with its disintegrator members 47 and a disc 48 with disintegrator members 49 disposed between the disintegrator members 47. These disintegrator members are so arranged that the outermost row of the disintegrator members 47 carried by the disc 46 are radially beyond the outermost row of the disintegrator members 49 carried by the disc 48. The outermost row of the disintegrator members 45 carried by the disc 44 are radially outside of and beyond the outermost row of the disintegrator members 43 carried by the disc 42.

The discs of the two disintegrator members are driven in any convenient manner. As shown, the shaft of a motor 50 on a base 51 is connected through suitable couplings 52 to the disc 42 and said shaft is connected by suitable chains and pulleys 53 to a sleeve 54 connected by a coupling 55 to the disc 46. Thus the discs 42 and 46 rotate in the same direction. A like arrangement on the other side of the casing 35 is provided by a motor 56 (on a base 50^a) the shaft of which motor is connected by a coupling 57, by a chain and pulleys 58 and coupling 59, respectively, to the discs 44 and 48 so as to rotate them in the same direction. The driving motors are so arranged as to drive the discs 44 and 48 in one direction and the discs 42 and 46 in the opposite direction. As a result, the rows of disintegrator members carried respectively by the discs 42 and 44 will be revolved in opposite directions as will also the disin-

tegrator members carried by the discs 46 and 48 and the outer row of disintegrator members 47 carried by the disc 46 will be revolved in a direction opposite to the outer row of disintegrator members 45 carried by the disc 44.

Water may be introduced into the system through the shafts 40 and 41, which are hollow and perforated for the purpose; but preferably water is introduced through the upper shaft 41 only.

In this apparatus the raw, hot gas entering through the conduit 36 meets the fine spray of water thrown out by the centrifugal action of the outermost row of disintegrator members carried by the disc 44. This spray of water by centrifugal force is thrown through the body of gas in a direction opposite to that in which the gas is flowing. As the gas passes upwardly through the oppositely revolving rows of disintegrator members 43 and 45 in the lower position of the movement of said disintegrators, the gas is subjected to a thorough disintegrating action and then after passing above the shaft 40 is subjected to a second disintegrating action at the upper level of operation of said disintegrators. It then passes into the space between the two sets of disintegrators where it it subjected to the centrifugal action of the water thrown in opposite directions from the outermost rows of disintegrators of the two sets of disintegrators. It then passes through and is subjected to the disintegrating action of the upper set of disintegrators first at the lower zone of operation of said disintegrators and then at the upper zone of operation of said disintegrators.

Thus in its passage through the casing the gas is subjected successively, first to the centrifugal action of water, then to two treatments of disintegrator action of the lower set of disintegrators, next to the centrifugal action of the water spray in opposite directions between the two sets of disintegrators and then to two successive disintegrator actions of the top disintegrator members.

Here again the clean water is applied to scrub the cleaner, cooler gas and the dirty water applied to scrub the hot, raw gas, providing as in the other case a more efficient interchange of temperature. The casing is fitted in this case as before at the bottom with a discharge pipe 60 to lead off the dirty water

It will be noted that in both cases the principle of the disintegrator washer is employed to thoroughly break up the water into fine spray and to beat it into and mix it with the gas so as to thoroughly wet the dust or solid particles contained therein and that in addition and simultaneously the principle of the centrifugal operating washer is employed to throw the fine water spray through the gas in order to thoroughly wet the dust and dirt particles and that this centrifugal discharge of the spray through the gas is in a direction opposite to the flow of the gas,—thus efficiently and thoroughly washing, cooling and cleaning the gas, with a minimum use of water and in a minimum of space for apparatus employed for the amount of gas treated.

While in describing the invention I have referred to and illustrated many details of mechanical construction and arrangement of parts, it is to be understood that the invention is in no way limited thereto except as may be pointed out in the appended claims.

I claim as my invention:

1. A gas washing apparatus comprising a vertical casing provided with a gas inlet at the bottom and a gas outlet at the top, a plurality of relatively revolving, oppositely moving, disintegrator members arranged to operate in a plurality of vertically spaced successive stages, means for introducing water near the top of the casing, and means for relatively revolving said disintegrator members, said disintegrator members being constructed and arranged to provide a tortuous path for said gas and water through said casing and to centifugally discharge said water in a direction counter to the flow of gas through said casing.

2. A gas washing apparatus comprising a vertical casing provided with a gas inlet at the bottom and a gas outlet at the top, a plurality of vertically spaced sets of oppositely revolving, horizontally disposed, disintegrator elements, means for revolvably mounting and driving said sets of disintegrator elements, and means for admitting water near the top of said casing, said sets of disintegrator elements being arranged and driven so that proximate elements of the several sets act to centrifugally discharge the water in opposite directions.

3. A gas washing apparatus comprising a vertical casing provided with a gas inlet at the bottom and a gas outlet at the top, a plurality of vertically spaced sets of oppositely revolving, horizontally disposed, disintegrator members, each set comprising horizontally spaced discs and a plurality of horizontally disposed radially spaced annular rows of interacting disintegrator elements carried by the discs, horizontal shafts on which said discs are mounted, means for introducing water at or near the upper shaft, and means for driving said shafts so that proximate disintegrator elements of the several sets of disintegrator members act to discharge the water in opposite directions.

4. A gas washing apparatus comprising a vertically extending casing provided with a gas inlet at the bottom and a gas outlet at the top, a plurality of sets of disintegrator members located in vertically spaced zones between said inlet and outlet, means for introducing water into said casing for contact by said members, and means for causing relative

movement between separate sets of said members, whereby the latter may centrifugally discharge said water towards the bottom of said casing in a direction counter to the flow of gas.

5. A gas washing apparatus comprising a vertically extending casing provided with a gas inlet at the bottom and a gas outlet at the top, a plurality of disintegrator members mounted in said casing, said members being arranged in sets located in vertically spaced zones, means for introducing water into any of said zones and in contact with a set of said members, and means for causing relative movement between the members of said set, whereby said members may centrifugally discharge said water towards the bottom of said casing in a direction counter to the flow of gas.

In testimony that I claim the foregoing as my invention, I affix my signature this 4th day of February, A. D. 1927.

EDMUND VON MALTITZ.