Nov. 7, 1950 R. C. ORTGIES 2,529,045

APPARATUS FOR CLEANING STACK GAS

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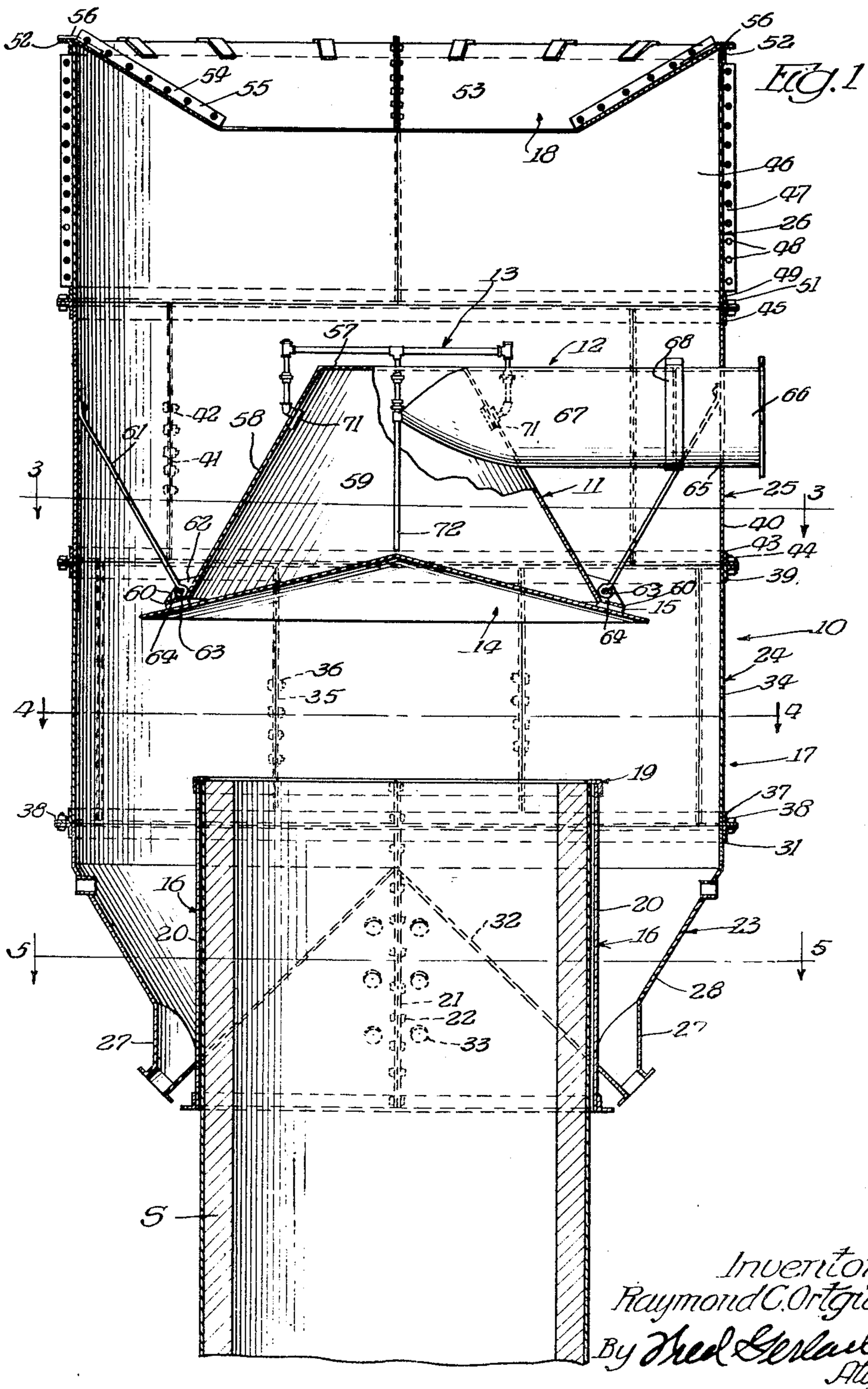

Fig. 1

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Fig. 2

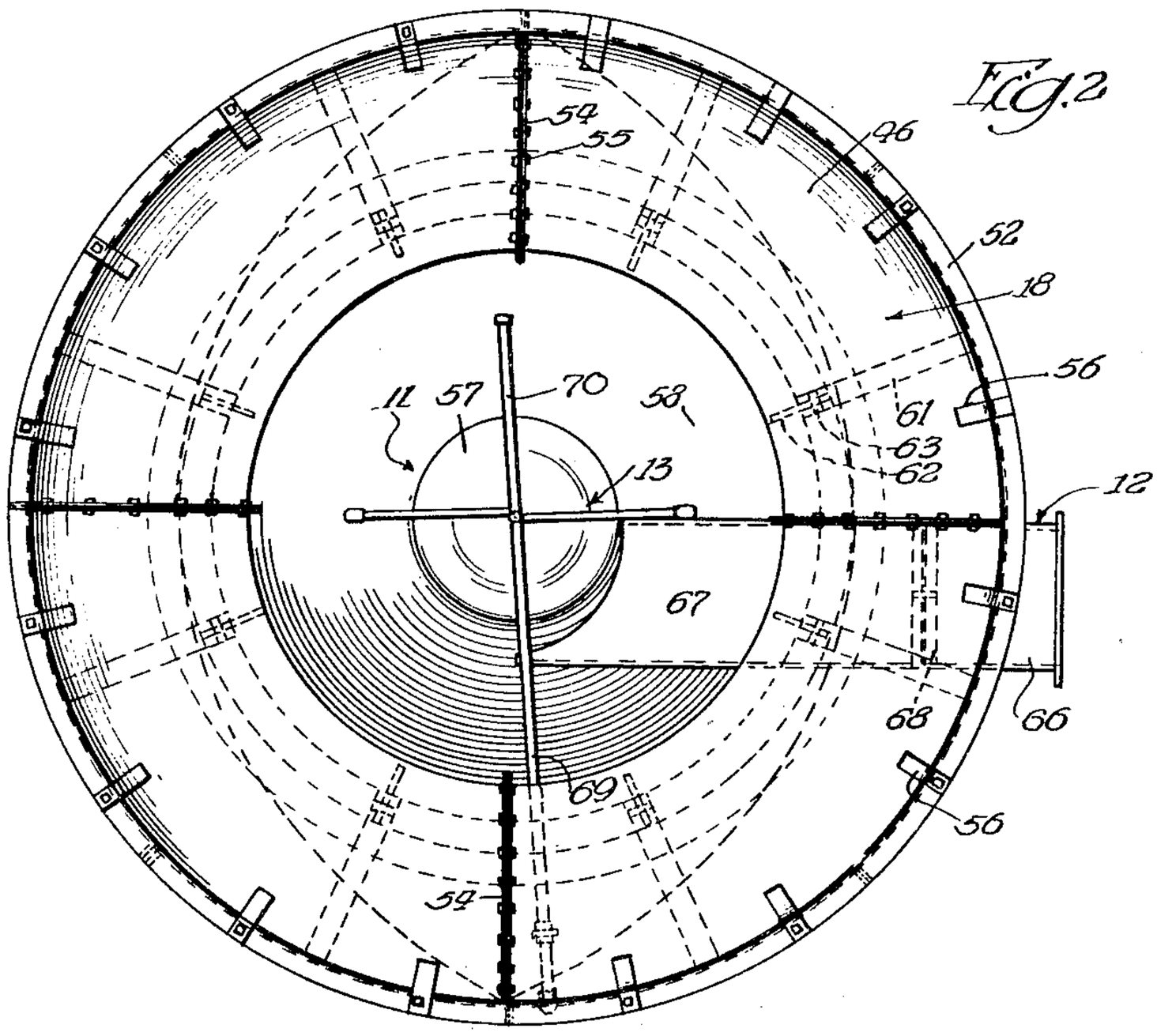

Fig. 3

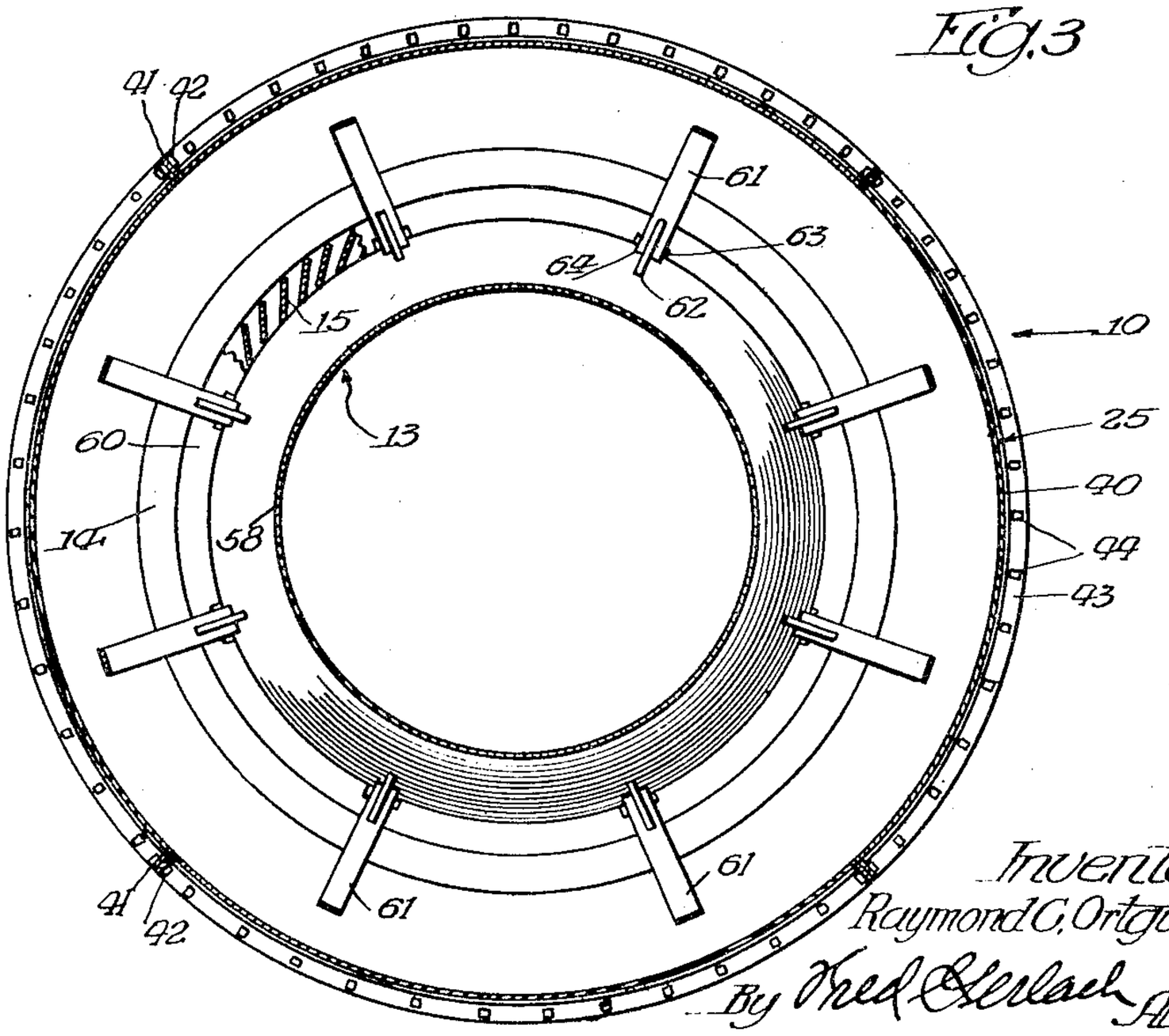

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FIG. 4

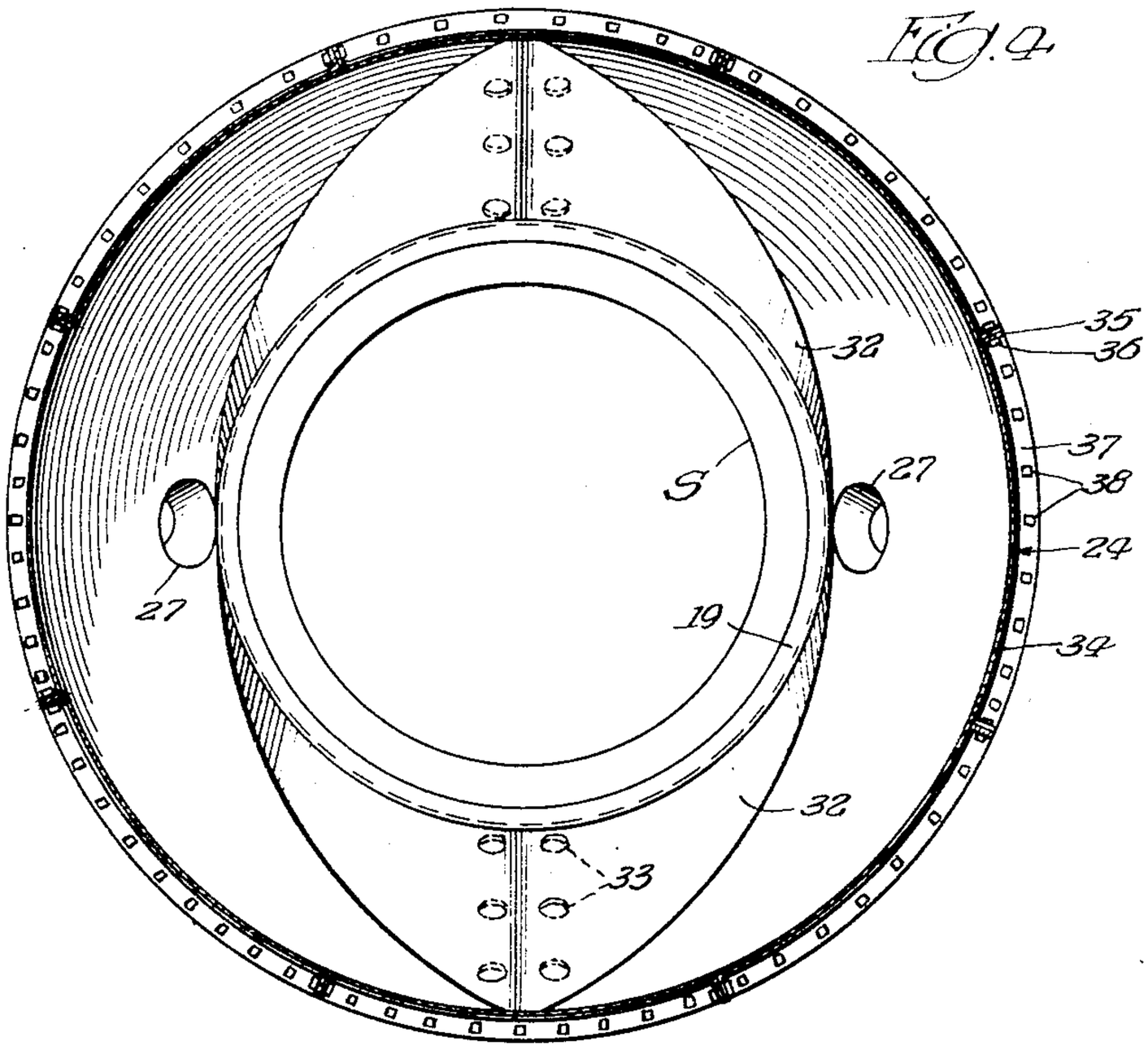
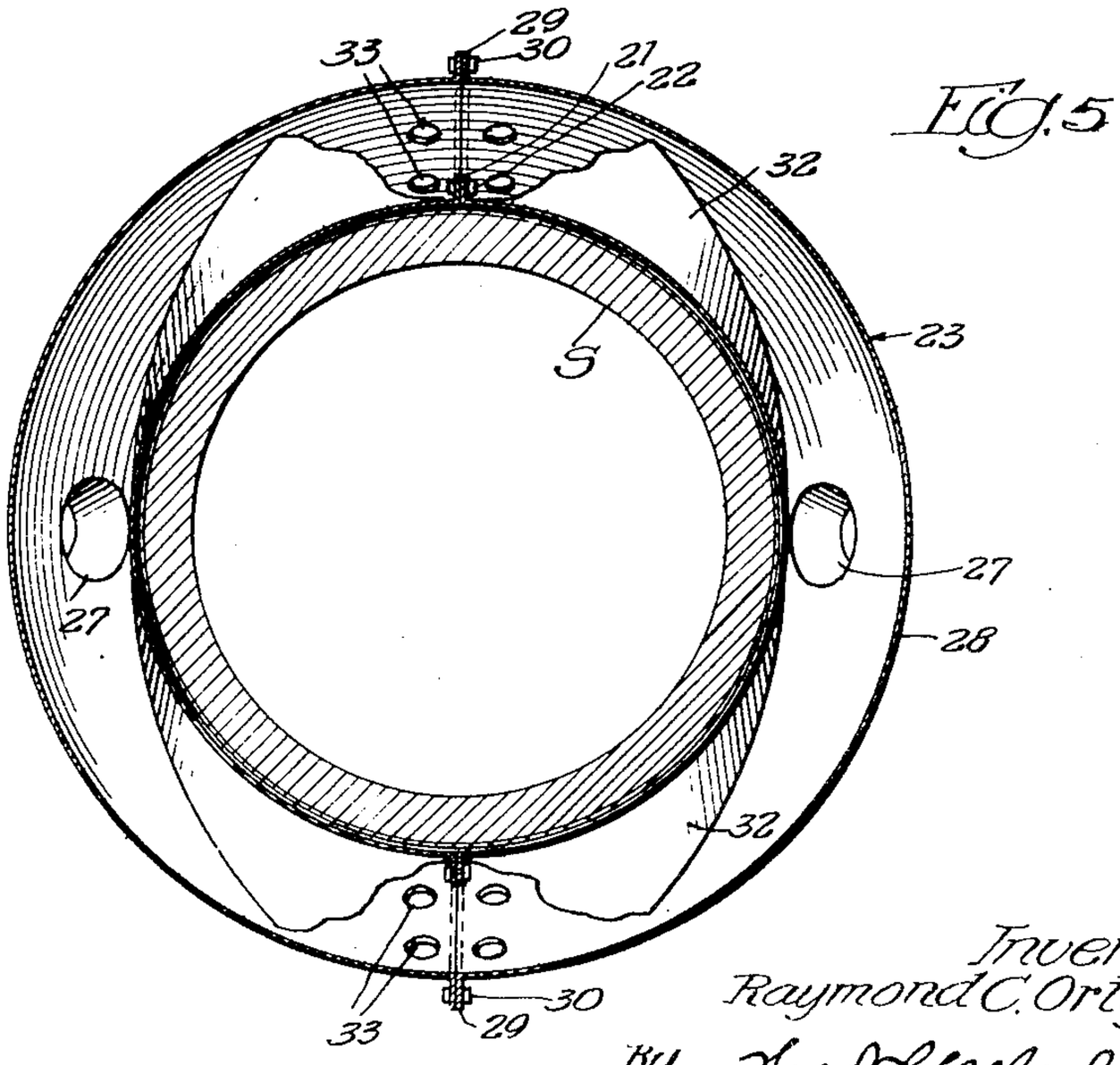


FIG. 5



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2,529,045

APPARATUS FOR CLEANING STACK GAS

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Application February 3, 1947, Serial No. 726,103

6 Claims. (Cl. 261—16)

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The present invention relates generally to gas cleaning apparatus. More particularly the invention relates to that type of apparatus which is adapted to form a continuation of the upper end of a stack, such, for example, as a cupola stack, serves in connection with the up-flow therethrough of the gas resulting from combustion in the cupola to rid the gas of dust and fly ash and also to suppress or quench sparks in the gas, and as its principal components or parts comprises: (1) a vertically extending elongated casing having a main outlet at its upper end and embodying a cylindrical inlet conduit and a side wall which is of circular cross section and greater maximum diameter than the inlet conduit and has the lower end thereof downwardly tapered, extending around the conduit and connected to the latter at a point beneath the upper end thereof; (2) an inverted cup shaped member which is disposed in the central portion of the casing and above, and in alignment with, the conduit, embodies an open bottom and consists of a top wall and a continuous side wall depending from the top wall and defining therewith an air chamber; (3) a duct which extends into the casing, has the inner end thereof leading through and extending tangentially with respect to the side wall of the cup shaped member and its outer end adapted for connection to a source of clean air under pressure, and serves to introduce the clean air under pressure into the air chamber so as to cause it to swirl therein; (4) a pipe system for spraying water into the air chamber for admixture with the swirling clean air; (5) a horizontally disposed deflector plate which is positioned between, and in spaced relation with, the open bottom of the cup shaped member and the upper end of the inlet conduit, is adapted to cause the dust laden gas emanating from the conduit and the swirling water containing clean air under pressure emanating from the open bottom of the cup shaped member to be deflected outwards towards the casing side wall in such manner that they mix together; and (6) an annular series of vertical angularly positioned vanes which extend between, and are connected to, the margin of the deflector plate and an outwardly extending flange on the lower end of the side wall of the cup shaped member and are arranged so as to augment swirling of the water containing clean air under pressure as it flows outwards from the deflector plate preparatory to mixing with the dust laden gas.

One object of the invention is to provide a gas cleaning apparatus of this type which is an improvement upon, and has certain inherent advantages over, previously designed apparatus for the same purpose.

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Another object of the invention is to provide a gas washing apparatus which is characterized by extremely high efficiency and ready replaceability of its various components or parts.

Another object of the invention is to provide a gas washing apparatus of the aforementioned type and character in which the side wall of the inverted cup shaped member and the outwardly extending annular flange on the lower end of such side wall are downwardly flared or frusto-conical to the end that free dust and fly ash in the gas within the chamber and sludge resulting from contact of the water with the dust in suspension in the swirling air under pressure emanating from the open bottom of the cup shaped member do not accumulate on the outer surfaces thereof.

Another object of the invention is to provide a gas cleaning apparatus of the last mentioned character in which the deflector plate that is disposed between and spaced from the upper end of the inlet conduit and the open bottom of the inverted cup shaped member is conical in order that the swirling water containing air under pressure emanating from the open bottom of the member is so directed that it intimately mixes with the dust laden gas emanating from the upper end of the conduit and causes such gas to swirl with it to the end that the dust and fly ash in the gas are impinged against the side wall of the casing and pass or flow downwards in the form of sludge to the conical lower end of the casing side wall.

A further object of the invention is to provide a gas cleaning apparatus of the type and character under consideration in which the cylindrical inlet conduit forming a part of the casing comprises a pair of semi-cylindrical bolted together sections and the lower downwardly tapered end of the casing side wall has hand holes which provide access to the bolts for securing together outlet forming sections and also permit air to circualte around portions of the conduit for cooling purposes.

A still further object of the invention is to provide a gas washing apparatus which is of generally new and improved construction, effectively and efficiently fulfills its intended purpose and is capable of being serviced with facility and also manufactured at a low cost.

Other objects of the invention and the various advantages and characteristics of the present gas

cleaning apparatus will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like letters and numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a vertical or longitudinal section of a gas cleaning apparatus embodying the invention;

Figure 2 is a plan view;

Figure 3 is a horizontal section taken on the line 3—3 of Figure 1, and illustrating in detail the manner in which the inverted cup shaped member is suspended within the central portion of the casing; and

Figures 4 and 5 are horizontal sections taken, respectively, on the lines 4—4 and 5—5 of Figure 1, and showing in detail the construction and design of the cylindrical inlet conduit and the lowermost section of the side wall of the casing.

The apparatus which is shown in the drawings constitutes the preferred form or embodiment of the invention. It is adapted to form a continuation or part of the upper end of a stack and serves as hereinafter described more in detail and in connection with the up-flow therethrough of the gas resulting from combustion, to rid the gas of dust and fly ash and also to suppress or quench sparks in the gas. In Figure 1 of the drawings the apparatus is shown as forming a part of the upper end of the stack S of a cupola. As its principal components the apparatus comprises a vertically elongated casing 10, an inverted cup shaped member 11 in the central portion of the casing, a horizontal duct 12 for supplying air under pressure into the member 11, a pipe system 13 for spraying water into the air in the inverted cup shaped member, a horizontally extending deflector plate 14 beneath the member 11 and an annular series of swirling vanes 15.

The vertically elongated casing 10 is formed for the most part of plate metal and consists of a cylindrical inlet conduit 16, a side wall 17 of circular cross section and an outlet conduit 18.

The cylindrical inlet conduit 16 is shaped to receive and fit around the upper end of the cupola stack S and embodies at its upper end an annular angle bar 19. The latter consists of a depending vertical leg and an inwardly extending horizontal leg. The depending vertical leg is welded or riveted to the upper end of the conduit 16 and the inwardly extending horizontal leg overlies and rests upon the upper end of the cupola stack S and serves to support the apparatus as a whole with respect to the stack. The internal diameter of the conduit 16 is slightly greater than the external diameter of the stack of the cupola. The conduit 16 consists of two semi-cylindrical complemental sections 20 and these have the end margins thereof bent outwards to form external right angle flanges 21 which are disposed in abutting relation and are removably secured together by horizontal bolts 22. The bolts extend through aligned holes in the flanges 21 and when removed from such holes permit the conduit sections 20 to be separated. The bolts 22 are spaced vertically apart and are preferably disposed throughout the entire length of the

flanges 21. The angle bar 19 is split or interrupted adjacent the flanges 21 in order that it is in the form of two semi-circular sections, each of which is associated with one of the conduit sections 20. When the cupola to which the apparatus is applied is in operation the gas resulting from combustion flows upwards through the stack S and enters the central portion of the casing 10 via the inlet conduit 16.

The side wall 17 of the casing is for the most part of materially greater diameter than the inlet conduit 16 and is disposed in concentric relation with the inlet conduit. It consists of a plurality of superposed annular units. Preferably there are four units and these are designated by the reference numerals 23, 24, 25 and 26.

The unit 23 is the lowermost unit as shown in Figure 1 of the drawings. It is downwardly tapered and surrounds the vertically extending cylindrical inlet conduit 20. The lower end of the unit 23 is provided with a pair of downwardly and outwardly extending diametrically opposite discharge nipples 27 and these are positioned adjacent the lower central portions of the inlet conduit sections 20 and serve as discharge means for the sludge that gravitates, as hereinafter described, into the unit 23. The latter consist of two complemental 180° sections 28 which are associated, respectively, with the two semi-cylindrical sections 20 constituting the inlet conduit 16. The lower or bottom margins of the sections 28 are welded to the lower marginal portions of the conduit sections 20 and the end margins of the sections 28 are bent or deflected outwards to form external right angle flanges 29. Such flanges are arranged in abutting relation and lie in the same vertical plane as the flanges 21 at the end margins of the outlet sections 20. Horizontal bolts 30 extend through aligned holes in the flanges 29 and serve releasably or removably to secure together the two complemental sections 28 constituting the lowermost unit 23 of the casing side wall 17. The upper margin of each section 28 is provided with an externally disposed semi-circular angle bar 31 consisting of a depending vertical leg and an outwardly extending horizontal leg. The depending vertical legs of the angle bars 31 are welded, riveted, or otherwise fixedly secured in place. By reason of the fact that the lower margins of the sections 28 are welded to the lower margins of the outlet sections 20 each section 28 and its associated outlet section 20 constitute a unitary structure. The two unitary structures are essentially complemental and may be separated from one another by removing the bolts 22 and 30. For the purpose of guiding into the discharge nipples 27 the sludge that gravitates into the lowermost unit 23 of the casing side wall 17 a pair of substantially flat U-shaped downwardly and oppositely inclined guide plates 32 is provided. These plates are disposed between the inlet conduit 16 and the lowermost unit 23 of the casing side wall and are, respectively, associated with the aforementioned two complemental unitary structures. The central or lower portions of the guide plates are disposed adjacent the lower portions of the inlet ends of the discharge nipples 27 and the upper end portions of the two plates abut against one another and are disposed adjacent and in alignment with the flanges 21 and the flanges 29. The outer edges of the guide plates are welded to the sections 28 of the lowermost unit 23 and the inner edges are welded to the conduit sections 20. In order to provide access to those bolts 22 that are

disposed beneath the upper end portions of the guide plates hand holes 33 are formed in the end margins of the sections 28. There are preferably three hand holes in each end margin and such hand holes are arranged in a vertically extending rectilinear series. The hand holes 33 have a twofold purpose in that they not only provide access to certain of the bolts 22 but also permit air to circulate through the spaces beneath the guide plates 32. The air that circulates through such spaces effects cooling of the inlet conduit 16 which, as heretofore described, surrounds the upper end of the cupola stack S.

The unit 24 of the casing side wall 17 is cylindrical and directly overlies and is the same in diameter as the upper end of the lowermost unit 23. It forms an upper continuation of the lowermost unit 23 and consists of an annular series of arcuate sections 34. Preferably such sections are eight in number. The end margins of the sections 34 are bent outwards to form external right angle flanges 35 which abut against one another and are releasably or removably secured together by way of horizontal bolts 36. The latter extend through aligned holes in the flanges 35. The lower margin of each section 34 is provided with an externally disposed arcuate angle bar 37 consisting of an upwardly extending vertical leg and an outwardly extending horizontal leg. The upwardly extending vertical legs of the angle bars 37 are welded or otherwise fixedly secured to the lower margins of the sections 34 and the outwardly extending horizontal legs rest on the outwardly extending horizontal legs of the angle bars 31 and are removably secured thereto by vertical bolts 38. The upper margin of each section 34 is provided with an externally disposed arcuate angle bar 39 consisting of a depending vertical leg and an outwardly extending horizontal leg. The angle bars 39 are arranged in parallel relation with the angle bars 37 and have the ends thereof terminating adjacent the end margins of the sections 34.

The unit 25 of the casing side wall 17 is cylindrical and overlies and rests on the unit 24. It is the same in diameter as said unit 24 and consists of a plurality of complemental arcuate sections 40. Preferably such sections are four in number. The end margins of the sections 40 are bent outwards to form external right angle flanges 41 which abut against one another and are releasably or removably secured together by way of horizontal bolts 42. The latter extend through aligned holes in the flanges 41. The lower margin of each section 40 is provided with an externally disposed arcuate angle bar 43 consisting of an upwardly extending vertical leg and an outwardly extending horizontal leg. The upwardly extending vertical legs of the angle bars 43 are welded or otherwise fixedly secured to the lower margins of the sections 40 and the outwardly extending horizontal legs rest on the outwardly extending horizontal legs of the angle bars 39 and are removably secured thereto by vertical bolts 44. The upper margin of each section 40 is provided with an externally disposed arcuate angle bar 45 consisting of a depending vertical leg and an outwardly extending horizontal leg. The angle bars 45 are arranged in parallel relation with the angle bars 43 and have the ends thereof terminating adjacent the end margins of the sections 40.

The unit 26 of the casing side wall 17 is cylindrical and overlies and rests on the unit 25. It is the same in diameter as said unit 25 and

consists of a plurality of complemetal arcuate sections 46. Preferably such sections are four in number. The end margins of the sections 46 are bent outwards to form external right angle flanges 47 which abut against one another and are releasably or removably secured together by way of horizontal bolts 48. The latter extend through aligned holes in the flanges 47. The lower margin of each section 46 is provided with an externally disposed arcuate angle bar 49 consisting of an upwardly extending vertical leg and an outwardly extending horizontal leg. The upwardly extending vertical legs of the angle bars 49 are welded or otherwise fixedly secured to the lower margins of the sections 46 and the outwardly extending horizontal legs rest on the outwardly extending horizontal legs of the angle bars 45 and are removably secured thereto by vertical bolts 51. The upper margin of each section 46 of the unit 26 is provided with an externally disposed arcuate angle bar 52 consisting of a depending vertical leg and an outwardly extending horizontal leg. The angle bars 52 are arranged in parallel relation with the angle bars 50 and have the ends thereof terminating adjacent the end margins of the sections 46. Preferably the arcuate sections 46 of the unit 26 are staggered or longitudinally offset with respect to the arcuate sections 40 of the unit 25.

The outlet conduit 18 is located adjacent and disposed within the upper end of the casing side wall 17 and, as best shown in Figure 1, is downwardly tapered. It consists of a plurality of complemental serially or annularly arranged sections 53 and has the diameter of its large end the same as the diameter of the unit 25. The sections 53 are the same in number as, and are associated respectively with, the sections 46 of the unit 26 and have the end margins thereof bent upwards to form vertically extending right angle flanges 54. The latter abut against one another and are removably secured together by way of horizontal bolts 55 which extend through aligned holes in the flanges 54. The upper or large end of the downwardly tapered outlet conduit 18 is connected to the upper end of the unit 26 constituting the upper end of the casing side wall 17 by way of an annular series of radially extending straps 56. The inner ends of these straps are welded to the upper or large end of the outlet conduit 18 and the outer ends of the straps overlie and are welded or bolted to the outwardly extending horizontal legs of the angle bars 52.

The advantage to the feature of forming the casing 10 of sectional units is that any one of the units may be removed either for purposes of replacement or to provide access to the interior of the casing. When it is desired to remove any one of the sections it is only necessary to remove the bolts that are associated therewith. Removal of such bolts releases the section so that it may be removed merely by shifting it sidewise or laterally away from the axis of the casing. When the cupola is in operation the dust and fly ash laden gas resulting from combustion enters the central portion of the casing interior via the cylindrical inlet conduit 16 and then, after being laterally deflected as hereinafter described, flows upwards and is exhausted from the casing via the downwardly tapered outlet conduit 18.

The inverted cup shaped member 11 is disposed in the central portion of the casing 10 and is for the main part surrounded by the unit 25 of the casing side wall 17. It is formed of plate

metal and consists of a flat circular top wall 57 and a frusto-conical or downwardly flared annular side wall 58. The side wall 58 depends from, and is joined to the marginal portion of, the top wall 57 and forms with said top wall an air chamber 59. The lower or large end of the side wall 58 is provided with an integral outwardly and downwardly inclined annular flange 60. The member 11 is supported in centered relation with the casing side wall 17 by way of an annular series of equidistantly spaced upstanding bars 61. The upper ends of the bars are welded to the sections 40 of the unit 25 and the lower ends of the bars are connected to the lower end of the side wall 58 of the member 11 by way of vertically extending plates 62 and horizontal bolts 63. The plates 62 are aligned with the bars 61 and are welded to the flange 60 on the lower end of the side wall 58. The lower ends of the bars 61 are bifurcated. They straddle the plates 62 and are bent or shaped to form eyes 64. The bolts 63 extend through the eyes 64 and aligned holes in the plates 62. The bars 61 are preferably eight in number and are arranged so that there are two bars on each of the sections 40 of the unit 25.

The duct 12 extends horizontally through a hole 65 in the unit 25 of the casing side wall 17 and has the outer end thereof adapted for connection to a source of clean air under pressure such, for example, as a blower (not shown). The inner end of the duct 12 is positioned tangentially with respect to the inverted cup shaped member 11 and is connected to, and leads through, the upper end of the frusto-conical or downwardly flared side wall 58. In view of the fact that the duct is tangentially arranged with respect to the inverted cup shaped member 11 the clean air under pressure entering the member is caused to swirl and passes through the open bottom of the member in a swirling manner. The duct 12 consists of an outer section 66 and an aligned inner section 67. The outer section is welded to the portion of the unit 25 that defines the hole 65. The inner section is aligned with the outer section and is detachably connected to the latter by way of a split clamp type ring 68.

The pipe system 13 serves to spray water into the upper end of the inverted cup shaped member 11 for admixture with the swirling clean air under pressure in the member. It comprises a horizontally extending feed pipe 69 and a plurality of branch pipes 70. The feed pipe 69 extends through one of the sections 40 of the unit 25 and has its outer end connected to any suitable source of water under pressure (not shown). The inner end of the feed pipe overlies and terminates adjacent the central portion of the top wall 57 of the inverted cup shaped member 58. The branch pipes 70 are preferably four in number and are connected to, and extend radially outwards from, the inner end of the feed pipe 69. The outer ends of the branch pipes extend downwards, lead through holes in the upper end of the side wall 58 of the member 11 and have splash plates 71 adjacent their lower or discharge ends. The splash plates serve to atomize or effect spraying of the water that is introduced into the upper end of the air chamber 59 by the branch pipe 70. When the water in spray form is mixed with the swirling clean air under pressure in the air chamber it forms a heavy fog or mist.

The horizontally disposed deflector plate 14 underlies and is in centered relation with the inverted cup shaped member 11. It is conical and

has a twofold purpose in that it serves to deflect outwards the dust laden gas emanating from the cylindrical inlet conduit 16 and also to deflect outwards the swirling water containing clean air emanating from the open bottom of the member 11. As best shown in Figure 1, the deflector plate 14 is of greater diameter than the inlet duct 16 and the outwardly and downwardly inclined flange 60 on the lower end of the side wall 58 of the member 11. The dust laden gas emanating from the inlet conduit 16, after impinging against the bottom surface of the deflector plate, is deflected outward and mixes with the swirling water containing clean air under pressure emanating from the open bottom of the member 11. It is caused to swirl with the clean air to the end that the dust, fly ash and other particles therein are thrown outwards by centrifugal force against the casing side wall 17. Because of the water in atomized, mist or fog form in the swirling clean air under pressure the dust, fly ash and other foreign particles are moistened to form sludge and the latter gravitates down the casing side wall and is discharged from the casing by way of the discharge nipples 27. The mixture of gas and air, after passing the deflector plate 14, flows upwards through the casing 10 and is exhausted via the downwardly tapered outlet conduit 18 at the upper end of the casing. In order to cool the deflector plate 14 a film of water is caused to flow over the upper surface of the plate. Such film is created by way of a vertically extending pipe 72 which is disposed centrally within the air chamber 59 in the inverted cup shaped member 11. The upper end of the pipe 72 extends through a hole in the central portion of the top wall 57 and is connected to the inner end of the feed pipe 69. The lower end of the pipe 72 overlies the central or apex portion of the deflector plate 14. By reason of the fact that the deflector plate 14 is of grater diameter than the cylindrical inlet conduit 16 the water that serves to cool the deflector plate and is delivered to the top surface of such plate by the pipe 72 does not, after flowing past the edge of the deflector plate, fall into the inlet conduit 16. By having the deflector plate 14 conical and the flange 60 on the lower end of the side wall 58 of the member 11 downwardly and outwardly inclined the swirling water containing clean air under pressure flows or swirls downwards as well as outwards after emanating from the open bottom of the member 11. As shown in Figure 1, the flange 60 is inclined at the same angle as the outer marginal portion of the deflector plate 14 with the result that it is in parallel relation with said marginal portion. By having the side wall 58 of the member 11 frusto-conical or downwardly flared and by having the flange 60 downwardly and outwardly inclined no dust, fly ash or sludge is permitted to accumulate on the side wall 58 of the flange 60. Also by having the side wall of the inverted cup shaped member frusto-conical or downwardly flared air under pressure with the water therein is caused to swirl downwards in convolutions that increase in size as the air travels downwards. In other words, by having the side wall of the member shaped as hereinbefore set forth maximum efficiency is obtained so far as swirling of the clean air under pressure is concerned and the swirling air emanates from the open bottom of the member at a comparatively rapid rate and in a pronounced swirling manner.

The annular series of swirling vanes 15 is dis-

posed between the flange 60 and the outer marginal portion of the conical deflector plate 14 and serves to augment swirling of the water containing clean air under pressure emanating from the open bottom of the inverted cup shaped member 11. The vanes extend vertically and are angularly positioned or disposed as shown in Figure 3. The upper ends of the vanes are connected to the under surface of the flange 60 and the lower ends of the vanes are connected to the top surface of the deflector plate 14. The vanes are spaced equidistantly apart and are spaced inwards of the edge of the deflector plate 14.

The herein described gas cleaning apparatus effectively and efficiently fulfills its intended purpose and is characterized by the fact that it may be assembled and dismantled with facility due to the sectional design of the casing 10. It is capable of being produced at a comparatively low cost and is so designed and constructed that it possesses a long life even though the dust laden gas that is circulated therethrough is at an extremely high temperature. In addition to ridding the gas of dust, fly ash, soot and other foreign particles the apparatus serves to suppress or quench any sparks in the gas. When the gas emanates from the upper end of the casing it is free from dust or soot.

Whereas the apparatus has been described in connection with a cupola stack it is to be understood that it may be applied to the stack of any other type of furnace and also that it has other capabilities of use insofar as gas cleaning is concerned. It is also to be understood that the invention is not to be restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. An apparatus of the character described comprising a vertically elongated casing in the form of an upstanding conduit adapted to have dust laden gas flow upwards therethrough, and a continuous side wall of materially greater maximum width than the conduit, having the lower end thereof extending around the conduit, connected to the latter at a point beneath the upper end thereof and provided with a discharge for collected matter, and having its upper end provided with a main outlet, an inverted cup shaped member disposed within the central portion of the casing side wall and above, and in alignment with, the conduit and embodying a circular top wall and a frusto-conical side wall depending from the top wall and defining therewith a downwardly flared open bottom air chamber, a duct extending into the casing, having the inner end thereof leading through the upper end of, and extending tangentially with respect to, the side wall of said member and its outer end adapted for connection with a source of clean air under pressure, and serving to introduce the clean air under pressure into the air chamber so that it is caused by the member side wall to swirl downwards and outwards in convolutions of progressively increasing size in a downward direction and thence flow downwards and outwards past the open bottom of the air chamber, a circular horizontally disposed deflector plate positioned between, and in spaced relation with, the lower end of side wall of the member and the upper end of the conduit and adapted to cause the dust laden gas emanating from said conduit and the swirling clean air under pressure emanating from said open bottom of the air chamber to be deflected outwards against the casing side wall in such manner that they mix together and the heavier dust particles are precipitated and fall by gravity to the lower end of the casing side wall from whence they are discharged via the aforementioned discharge, and an annular series of vertical angularly positioned vanes extending between the margin of the deflector plate and the lower end of the side wall of the member and arranged so as to augment swirling of the clean air under pressure as it flows outwards from the deflector plate preparatory to mixing with the dust laden gas.

2. An apparatus of the character described comprising a vertically elongated casing in the form of an upstanding conduit adapted to have dust laden gas flow upwards therethrough, and a continuous side wall of materially greater maximum width than the conduit, having the lower end thereof extending around the conduit, connected to the latter at a point beneath the upper end thereof and provided with a discharge for collected matter, and having its upper end provided with a main outlet, an inverted cup shaped member disposed within the central portion of the casing side wall and above, and in alignment with, the conduit and embodying a circular top wall and a completely frusto-conical side wall depending from the top wall and defining therewith a downwardly flared open bottom air chamber, a duct extending into the casing, having the inner end thereof leading through the upper end of, and extending tangentially with respect to, the side wall of the said member and its outer end adapted for connection with a source of clean air under pressure, and serving to introduce the clean air under pressure into the air chamber so that it is caused by the member side wall to swirl downwards and outwards in convolutions of progressively increasing size in a downward direction and thence flow downwards and outwards past the open bottom of the air chamber, a horizontally disposed gradually sloping conical deflector plate positioned between, and in spaced relation with, the lower end of the side wall of the member and the upper end of the conduit and adapted to cause the dust laden gas emanating from said conduit and the swirling clean air under pressure emanating from said open bottom of the member to be deflected outwards and downwards against the casing side wall in such manner that they mix together and the heavier dust particles are precipitated and fall by gravity to the lower end of the casing side wall from whence they are discharged via the aforementioned discharge, and an annular series of vertical angularly positioned vanes extending between the margin of the deflector plate and the lower end of the side wall of the member and arranged so as to augment swirling of the clean air under pressure as it flows outwards and downwards from the deflector plate preparatory to mixing with the dust laden gas.

3. An apparatus of the character described comprising a vertically elongated casing in the form of an upstanding conduit adapted to have dust laden gas flow upwards therethrough, and a continuous side wall of materially greater maximum width than the conduit, having the lower end thereof extending around the conduit, connected to the latter at a point beneath the upper end thereof and provided with a discharge

for collected matter, and having its upper end provided with a main outlet, an inverted cup shaped member disposed within the central portion of the casing side wall and above, and in alignment with, the conduit, provided with an open bottom, and embodying a flat circular top wall and a completely frusto-conical side wall connected directly to, and depending from, the margin of the top wall, defining therewith a downwardly flared air chamber and provided at its lower end with an outwardly and downwardly inclined annular flange, a duct extending into the casing, having the inner end thereof leading through the upper end of, and extending tangentially with respect to, the side wall of said member and its outer end adapted for connection with a source of clean air under pressure, and serving to introduce the clean air under pressure into the air chamber so that it is caused by the member side wall to swirl downwards and outwards in convolutions of progressively increasing size in a downward direction and thence flow downwards and outwards past the open bottom of the air chamber, a circular horizontally disposed deflector plate positioned between, and in spaced relation with, the open bottom of the member and the upper end of the conduit and adapted to cause the dust laden gas emanating from said conduit and the swirling clean air under pressure emanating from said open bottom of the member to be deflected outwards against the casing side wall in such manner that they mix together and the heavier dust particles are precipitated and fall by gravity to the lower end of the casing side wall from whence they are discharged via the aforementioned discharge, and an annular series of vertical angularly positioned vanes extending between, and connected to, the margin of the deflector plate and the aforesaid flange and arranged so as to augment swirling of the clean air under pressure as it flows outwards and downwards from the deflector plate preparatory to mixing with the dust laden gas.

4. An apparatus of the character described comprising a vertically elongated casing in the form of an upstanding conduit adapted to have dust laden gas flow upwards therethrough, and a continuous side wall of materially greater maximum width than the conduit, having the lower end thereof extending around the conduit, connected to the latter at a point beneath the upper end thereof and provided with a discharge for collected matter, and having its upper end provided with a main outlet, an inverted cup shaped member disposed within the central portion of the casing side wall and above, and in alignment with, the conduit, provided with an open bottom, and embodying a circular top wall and a completely frusto-conical side wall depending from the top wall, defining therewith a downwardly flared air chamber, and provided at its lower end with an outwardly and downwardly inclined annular flange, a duct extending into the casing, having the inner end thereof leading through the upper end of, and extending tangentially with respect to, the side wall of said member and its outer end adapted for connection with a source of clean air under pressure, and serving to introduce the clean air under pressure into the air chamber so that it is caused by the member side wall to swirl downwards and outwards in convolutions of progressively increasing size in a downward direction and thence flow downwards and outwards past the open bottom of the air chamber, a horizontally disposed, gradually sloping conical deflector plate positioned between, and in spaced relation with, the open bottom of the member and the upper end of the conduit and adapted to cause the dust laden gas emanating from said conduit and the swirling clean air under pressure emanating from said open bottom of the member to be deflected outwards and downwards against the casing side wall in such manner that they mix together and the heavier dust particles are precipitated and fall by gravity to the lower end of the casing side wall from whence they are discharged via the aforementioned discharge, and an annular series of vertical angularly positioned vanes extending between, and connected to, the margin of the deflector plate and the aforesaid flange and arranged so as to augment swirling of the clean air under pressure as it flows outwards and downwards from the deflector plate preparatory to mixing with the dust laden gas.

5. An apparatus of the character described comprising a vertically elongated casing in the form of an upstanding conduit adapted to have dust laden gas flow upwards therethrough, and a continuous side wall of materially greater maximum width than the conduit, having the lower end thereof extending around the conduit, connected to the latter at a point beneath the upper end thereof and provided with a discharge for collected matter, and having its upper end provided with a main outlet, an inverted cup shaped member disposed within the central portion of the casing side wall and above, and in alignment with, the conduit, provided with an open bottom, and embodying a circular top wall and a frusto-conical side wall depending from the top wall and defining therewith a downwardly flared air chamber, a duct extending into the casing, having the inner end thereof leading through the upper end of, and extending tangentially with respect to, the side wall of said member and its outer end adapted for connection with a source of clean air under pressure, and serving to introduce the clean air under pressure into the air chamber so that it is caused by the member side wall to swirl in the air chamber and flow downwards in a swirling fashion to the open bottom of the member, a pipe system adapted to spray water into the the air chamber for admixture with the swirling clean air under pressure and comprising a feed pipe extending through the casing side wall and having its inner end overlying the cup shaped member and a plurality of branch pipes having certain ends thereof connected to the inner end of the feed pipe and their other ends extending through the upper end of the side wall of the member, a circular horizontally disposed deflector plate positioned between, and in spaced relation with, the open bottom of the member and the upper end of the conduit and adapted to cause the dust laden gas emanating from said conduit and the swirling water containing clean air under pressure emanating from said open bottom of the member to be deflected outwards towards the casing side wall in such manner that they mix together, and an annular series of vertical angularly positioned vanes extending between the margin of the deflector plate and the lower end of the side wall of the member and arranged so as to augment swirling of the water containing clean air under pressure as it flows outwards from the deflector plate preparatory to mixing with the dust laden gas.

6. An apparatus of the character described

comprising a vertically elongated casing in the form of an upstanding conduit adapted to have dust laden gas flow upwards therethrough, and a continuous side wall of materially greater maximum width than the conduit, having the lower end thereof extending around the conduit, connected to the latter at a point beneath the upper end thereof and provided with a discharge for collected matter, and having its upper end provided with a main outlet, an inverted cup shaped member disposed within the central portion of the casing side wall and above, and in alignment with, the conduit, provided with an open bottom, and embodying a circular top wall and a frusto-conical side wall depending from the top wall and defining therewith a downwardly flared air chamber, a duct extending into the casing, having the inner end thereof leading through the upper end of, and extending tangentially with respect to, the side wall of said member and its outer end adapted for connection with a source of clean air under pressure, and serving to introduce the clean air under pressure into the air chamber so that it is caused by the member side wall to swirl in the air chamber and flow downwards in a swirling fashion to the open bottom of the member, a pipe system adapted to spray water into the air chamber for admixture with the swirling clean air under pressure and comprising a feed pipe extending through the casing side wall and having its inner end overlying the cup shaped member and a plurality of branch pipes having certain ends thereof connected to the inner end of the feed pipe and their other ends extending through the upper end of the side wall of the member, a horizontally disposed, gradually sloping conical deflector plate positioned between, and in spaced relation with, the open bottom of the member and the upper end of the conduit and adapted to cause the dust laden gas emanating from said

conduit and the swirling water containing clean air under pressure emanating from said open bottom of the member to be deflected outwards and downwards towards the casing side wall in such manner that they mix together, means for flowing a film of water over the deflector plate consisting of a vertical pipe disposed centrally within the member and having the upper end thereof extending through the top wall of the member and connected to the inner end of the feed pipe and its lower end positioned directly over the apex of said deflector plate, and an annular series of vertical angularly positioned vanes extending between the margin of the deflector plate and the lower end of the side wall of the member and arranged so as to augment swirling of the water containing clean air under pressure as it flows outwards and downwards from the deflector plate preparatory to mixing with the dust laden gas.

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