July 26, 1960 A. H. KIRKBY 2,946,569

APPARATUS FOR CLEANING THE SURFACES OF HEAT EXCHANGE MEANS

Filed June 17, 1954 3 Sheets-Sheet 1

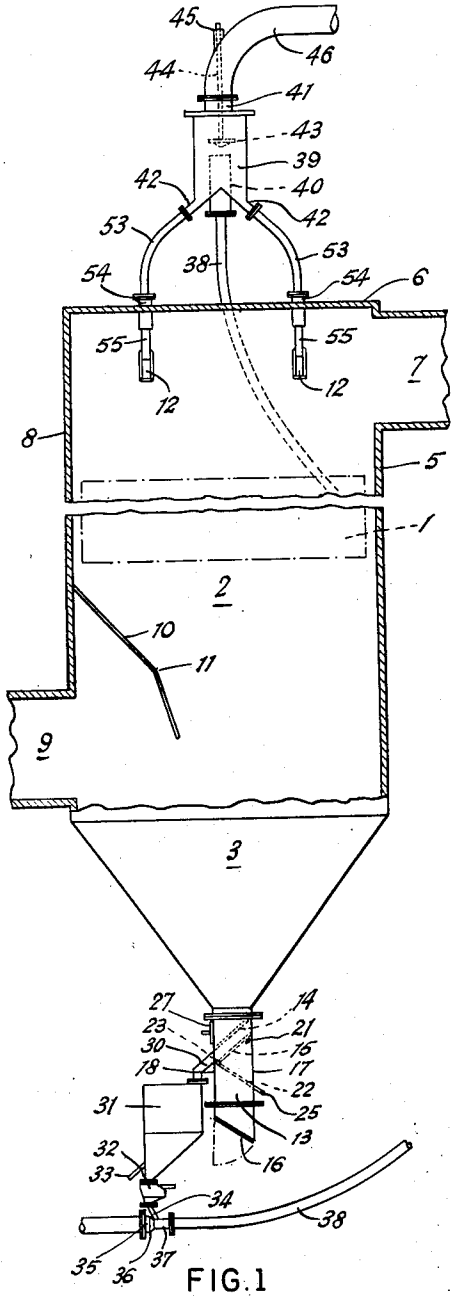


FIG. 1

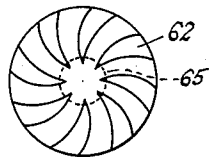


FIG. 8

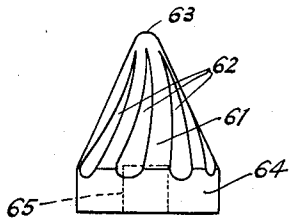


FIG. 7

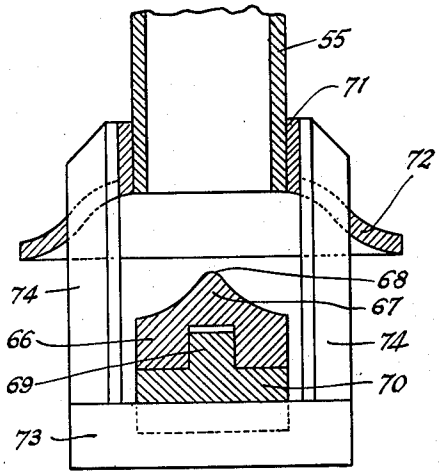


FIG. 9

INVENTOR
Albert H. Kirkby
BY
J. P. Moran
ATTORNEY

July 26, 1960 A. H. KIRKBY 2,946,569

APPARATUS FOR CLEANING THE SURFACES OF HEAT EXCHANGE MEANS

Filed June 17, 1954 3 Sheets-Sheet 2

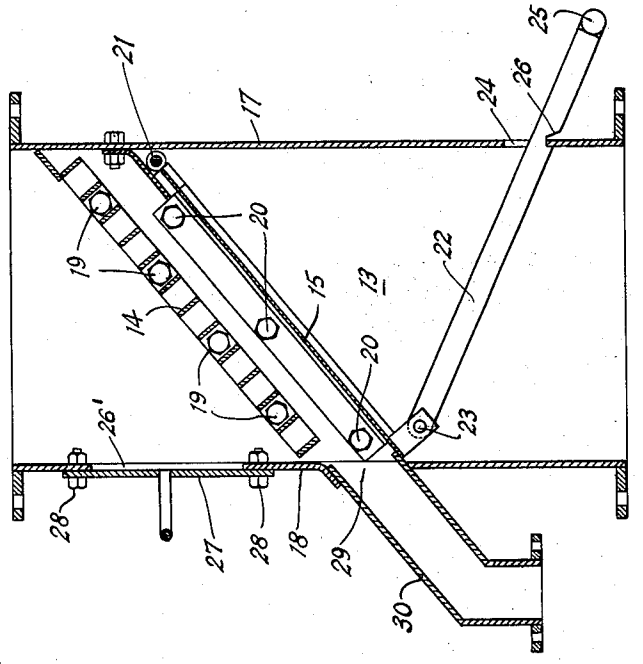


FIG. 3

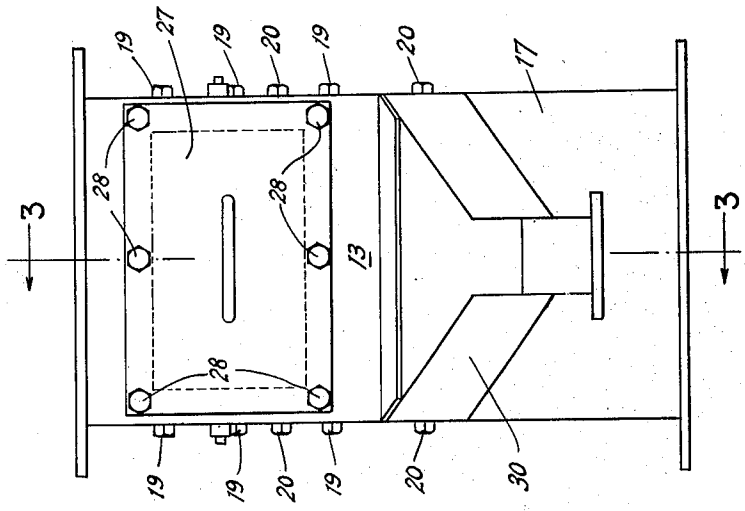


FIG. 2

INVENTOR
Albert H. Kirkby
BY
ATTORNEY

July 26, 1960 A. H. KIRKBY 2,946,569

APPARATUS FOR CLEANING THE SURFACES OF HEAT EXCHANGE MEANS

Filed June 17, 1954 3 Sheets-Sheet 3

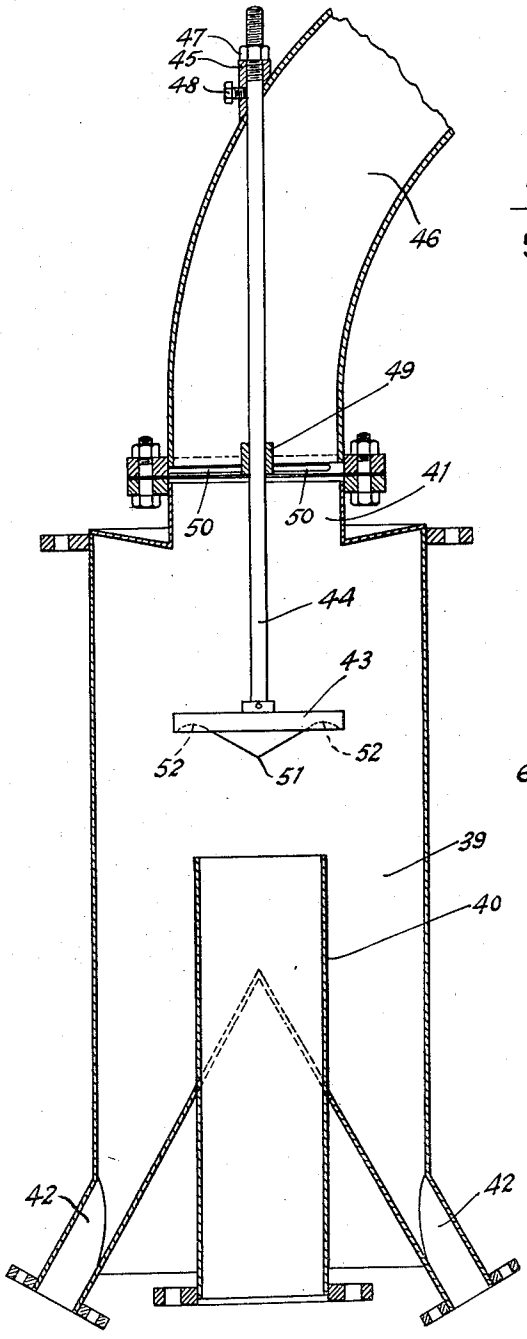


FIG. 4

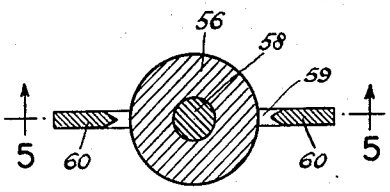


FIG. 6

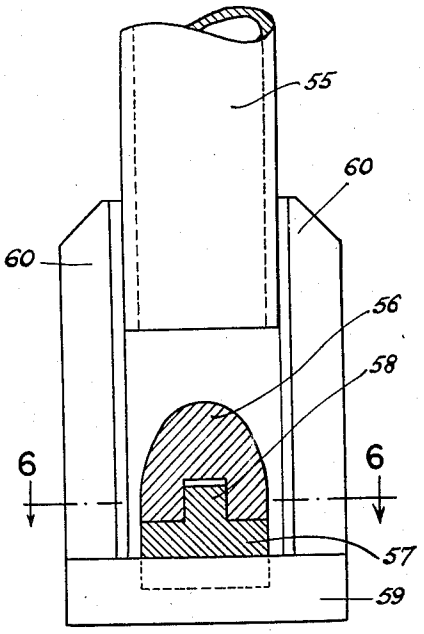


FIG. 5

INVENTOR
Albert H. Kirkby
BY
ATTORNEY

United States Patent Office 2,946,569 Patented July 26, 1960

2,946,569

APPARATUS FOR CLEANING THE SURFACES OF HEAT EXCHANGE MEANS

Albert Harry Kirkby, Boreham Wood, England, assignor to The Babcock & Wilcox Company, New York, N.Y., a corporation of New Jersey

Filed June 17, 1954, Ser. No. 437,455

Claims priority, application Great Britain June 18, 1953

2 Claims. (Cl. 257—1)

This invention relates to apparatus for cleaning the surfaces of heat exchange means. In tubulous vapour generators great difficulty is sometimes experienced, particularly in connection with banks of horizontal tubes in upright passes, in maintaining cleanliness of the surfaces of the heat exchange means over which the furnace gases flow. The problem tends to become particularly acute when the furnaces are fired by coal containing chlorine, coal comprising 20% of ash and 0.5% chlorine, for example, being notorious for its fouling properties. In order to remove deposits from tubes in an upright gas pass a system has been proposed whereby a shower of solid cleaning particles is caused to fall in the pass and in falling to dislodge the deposits. An object of the invention is the provision of an improved system of this nature. A more specific object is the provision of a simple but effective means for exerting a spreading action on a stream of solid cleaning particles so that the particles are distributed within an upright pass over the whole or substantially the whole of the surfaces of heat exchange means within the pass with which the particles in falling impact.

In apparatus for cleaning the surfaces of heat exchange means in an upright gas pass, comprising distributing means for exerting a spreading action on a stream of solid cleaning particles so that the particles are distributed within the pass in relation to surfaces of the heat exchange means with which the particles in falling impact, according to the present invention the distributing means include a stationary deflector and means for directing the stream of particles downwardly and causing the particles to be scattered through impact with the deflector.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a partly diagrammatic front elevation of a vertical gas pass provided with cleaning apparatus in accordance with the invention, part of the front wall and a central part of the pass being omitted;

Figure 2 is a side elevation of the particle collecting duct shown in Figure 1 to a larger scale than that figure;

Figure 3 is a sectional front elevation on the line 3—3 of Figure 2;

Figure 4 is a sectional front elevation of the separator shown in Figure 1 to a larger scale than that figure;

Figure 5 is a partly sectional side elevation of a distributor of the cleaning apparatus shown in Figure 1, to a larger scale than that figure, the section being taken on line 5—5 of Figure 6;

Figure 6 is a sectional plan view of the distributor shown in Figure 5, the section being taken on line 6—6 of that figure;

Figure 7 is a side elevation of an alternative form of deflector to that shown in Figures 5 and 6;

Figure 8 is a plan view of the deflector shown in Figure 7; and

Figure 9 is a sectional side elevation of an alternative form of distributor to that shown in Figures 5 and 6.

In Figure 1 of the drawings heat exchange means 1, which comprise banks of horizontal tubes and which may, for example, form an economizer, an air heater or a low temperature superheater, are mounted in a vertical gas pass 2, of which the width, between side walls, is approximately twice the depth between front and rear walls, and which is provided at its lower end with a hopper 3. In one side wall 5 and adjacent the roof 6 of the pass is a gas inlet 7, and in the opposite side wall 8 and adjacent the top of the hopper 3 is a gas outlet 9. A deflecting plate 10, extending across the pass between the front and rear walls, is secured to the wall 8 a short distance below the lowermost of the heat exchange means and slopes downwardly and inwardly towards the centre of the pass. Beyond a point 11 intermediate its length the deflecting plate slopes downwardly at a steeper angle and terminates at a level intermediate the height of the gas outlet 9.

In the gas turning space at the top of the pass 2 between the gas inlet 7 and the uppermost of the heat exchange means 1 are two distributors 12 disposed centrally between the front and rear walls and respectively spaced from the side walls 5 and 8 a distance about a quarter of the width of the pass.

Below the hopper 3 and attached to the outlet therefrom is a particle collecting duct 13, the construction of which is shown more clearly in Figures 2 and 3, provided internally with two screens 14 and 15 and at its lower end with a damper 16. As shown in Figure 3 the upper screen 14 is of larger mesh and more robust construction than the lower screen 15 and both slope downwardly from points near the top of one wall 17 and extend across the duct 13 to the opposite wall 18. The screen 14 is supported by means of bolts 19 and the screen 15 is supported by means of bolts 20. The screen 15 is also provided with a pivotal support 21 and a strut 22. The strut 22 is pivotally attached to the lower end of the screen 15 at 23, extends across the duct 13 and through an aperture 24 in the wall 17 and terminates in a handle 25 externally of the duct. A slot 26 in the strut engages the lower edge of the aperture 24 and holds the screen in the position shown. In the wall 18 between the top of the duct and the lower end of the screen 14 is an aperture 26' which is provided with a removable cover 27 held in position by bolts 28. A further aperture 29 is formed in the wall 18 and extends across the duct and between the lower ends of the screens 14 and 15. A chute 30 is mounted externally of duct 13 and is attached thereto around the aperture 29 in the wall 18. The chute is connected to a collecting bin 31 which has a bottom outlet provided with a cut-off valve 32. The bin 31 is also provided at a point a short distance above its bottom outlet with an overflow spout 33 having suitable closing means (not shown). A short pipe 34 connects the valve 32 with an entraining nozzle 35 which includes a relatively short converging portion 36 and a relatively long diverging portion 37, the pipe 34 being connected to the latter at a point adjacent the junction of the two portions.

The nozzle 35 is set in a pipe line 38 which connects it with the inlet to a solid particle separator 39 the construction of which is shown more clearly in Figure 4. The separator is provided with a cylindrical, upwardly directed inlet spout 40 of larger diameter than the pipe line 38, a gas outlet 41 and two solid particle outlets 42. An impact plate 43 is supported, within the separator and

in axial alignment with the inlet spout, on a rod 44 which passes through a bore in a boss 45 mounted on a discharge duct 46 which is attached to the outlet 41. An upper part of the rod 44 is threaded and carries a nut 47 which engages the upper face of the boss 45 and thus provides an adjustable support for the impact plate. A set screw 48 is mounted in a radial threaded hole in the boss 45 and can be tightened in order to hold the rod 44. At a point intermediate its length the rod 44 passes through a boss 49 which is supported from the flange of the outlet 41 by a spider 50 and which maintains the impact plate 43 in axial alignment with the spout 40. The impact plate 43 is circular and is formed with a lower surface which, in diametral cross-section, first slopes upwardly from a central peak 51 and then curves downwardly to form an inverted annular channel 52 near the periphery. Pipes 53 are attached to the outlets 42, pass through gas-tight seals 54 in the roof 6 and terminate in spouts 55 which form parts of the distributors 12.

In Figures 5 and 6 of the drawings one embodiment of a distributor 12 including a spout 55 is shown. A deflector 56, in this embodiment of substantially parabolic form in diametral cross-section, rests on a disc 57 and is located thereon by a spigot 58, integral with the disc, which enters a recess in the base of the deflector. A narrow cross piece 59 enters a diametral slot in the base of the disc and is welded thereto. Arms 60 which, in transverse cross-section, taper symmetrically inwardly are welded to the extremities of the cross piece which project beyond the disc. The upper parts of the arms 60 are welded to the outer surface of the spout 55.

In Figures 7 and 8 of the drawings, a deflector has an upper part 61 of substantially conical shape formed with flutes 62 and a rounded peak 63, and a cylindrical base part 64 formed with a recess 65 for engagement with a spigot such as spigot 58 of Figure 2. The flutes 62 start immediately below the peak 63 and increase in width and depth as they extend in a curved manner towards the periphery of the deflector.

In Figure 9 of the drawings, the deflector has a cylindrical base part 66 and an upper part 67 formed with a surface which slopes with increasing steepness towards a central rounded peak 68. The base part 66 is formed with a recess for engagement with a spigot 69 which is formed integrally with a disc 70 on which the deflector rests. A cylindrical part 71 of an annular hood 72 is secured to a spout 55 and, as seen in diametral cross-section, the hood slopes downwardly from the inner edge to the outer edge first with increasing and then with decreasing steepness. The disc 70 is supported on a cross-piece 73 which enters a diametral slot in the base thereof, and arms 74, welded to the extremities of the cross piece, extend through suitable apertures in the hood 72 and are welded to the cylindrical part 71. The arms 74 have a transverse cross-section similar in shape to the arms 60 of Figures 5 and 6.

Referring to Figures 1 to 6 of the drawings, in operation, cleaning particles, of irregular shape, leave the separator 39 through the outlets 42 and pass down the pipes 53 to the spouts 55. The particles are directed by the spouts to strike the deflectors 56 and are thereby scattered over substantially the whole of the horizontal cross-section of the pass 2, so that they fall through the heat exchange means 1 and clean the surfaces thereof. The particles, after passage through the heat exchange means, fall into the hopper 3, those particles which leave the means adjacent the wall 8 being deflected towards the centre of the pass by the deflecting plate 10 and so prevented from being swept into the gas outlet 9 by the stream of furnace gases flowing through the pass. Fine particles of matter removed from the surfaces of the heat exchange sections by the cleaning particles are carried by the stream of furnace gases through the gas outlet 9. Impact of the cleaning particles when they leave the hopper 3 with the screens 14 and 15 tends to loosen any matter removed from the surface of the heat exchange means and adhering to the cleaning particles and such loosened matter is carried, by a stream of air induced by the draught of the heat exchanger of which the pass 2 is part, back into the stream of furnace gases and so through the gas outlet 9. The stream of air may be controlled by the damper 16. The screen 14 is of sufficiently large mesh to allow all the cleaning particles to pass and is sufficiently strong to arrest large pieces of slag or brick and prevent them entering and damaging the cleaning particle circulation system. The screen 15 is of such mesh that it will arrest all the cleaning particles except those which have been worn down by repeated use to a size which renders them unsuitable for cleaning purposes. The undersized particles fall through the duct 13, pass over the damper 16 and fall into a suitable receptacle (not shown). The cleaning particles arrested by the screen 15 pass under the action of gravity down its surface, and down the chute 30 into the bin 31. From the bin 31 the particles pass through the shut-off valve 32 and the pipe 34 into the nozzle 35 where they are entrained in a stream of air under pressure and are carried through the pipe line 38 to the separator 39. In the separator the speed of the particles is reduced in the inlet spout 40 by reason of its larger diameter and they then strike the impact plate and fall towards the outlets 42, while the air leaves the separator through outlet 41 and is discharged through the duct 46. The particles then pass down the pipes 53 to the distributors 12 and are again scattered over the heat exchange sections 1.

In the embodiment shown in Figures 5 and 6 and in the modification shown in Figures 7 and 8, the particles strike the deflector alone but in the modification shown in Figure 9 most of the particles which rebound from the upper surface of the deflector strike the hood 72 before being scattered within the pass 2. The flutes 62 formed on the deflector shown in Figures 7 and 8 assist in the scattering of the cleaning particles. Similar flutes may also be formed on the deflector shown in Figures 5 and 6. The shape of the arms 60 and 74 lessens the obstruction to the flight of the particles offered by the arms thus reducing the area at the top of the pass not reached by the particles.

If, during operation, the screen 15 becomes clogged or, for some reason, particles accumulate in the duct 13 the bolts 20 may be removed and the screen allowed to swing down against the wall 17 under control of the strut 22 when the particles will fall through the duct 13, pass over the damper 16 and fall into a suitable receptacle (not shown) and the upper surface of the screen may be cleaned. In the event of a piece of brick or slag being arrested by the screen 14 it may be removed, at a convenient time, through the aperture 26. In the event that particles accumulate in the bin 31 and, for some reason, cannot be carried away by the circulation system at a sufficiently high rate, some particles can be removed through the overflow spout 33.

During operation, the number of particles in the system which is depleted by the rejection of undersized particles can be replenished by the addition of new particles to those in the bin 31 which is provided with a closeable opening for the purpose.

When, after some period of operation, it is desired to discard a worn deflector it may be lifted from the distributor and a new deflector may be located, by means of the spigots 58 or 69, in exactly the same position.

Advantageously, the internal diameter of the spouts 55 may, for example, be from 2" to 2¼", whilst the maximum diameter of a deflector may be about 2¾". The cleaning particles may, for example, be of wrought iron, pig iron or mild steel in the form of irregularly shaped slot the maximum dimensions of which are no greater than approximately 5/16" and no less than 3/16" and, in this case, the screen 15 may have a mesh of about 1/8".

It will be understood that the number of distributors provided within a pass is commensurate with the area of the heat exchange means in the pass and the area which is covered by the particles scattered by one distributor.

The irregular shape of the particles affords a more irregular pattern of flight from a deflector and thus a wider area is covered than would be with particles of spherical shape. A further advantage accruing from the use of irregularly shaped particles is the particularly vigorous scrubbing action exerted on the surfaces of the heat exchange sections.

I claim:

1. Apparatus for cleaning the surfaces of heat exchange means in an upright gas pass, having a roof, side walls, and a bottom wall, said apparatus comprising, in combination, means for collecting solid cleaning particles from the gas pass and disposed at a location below the gas pass, means for removing oversize and undersize particles from said solid cleaning particles including spaced coarse and fine screens positioned between said gas pass and said collecting means whereby a selected size of solid cleaning particle is gravitationally delivered to said collecting means, a separator at a location above the gas pass, pneumatic conveying means connecting the collecting means to said separator to return the particles to the latter, a gravity flow particle discharge spout extending from said separator through the roof of the gas pass and having a discharge end above the heat exchange means in the gas pass, a stationary deflector supported from said spout within the gas pass in downwardly spaced relation to said discharge end, said deflector being in the form of a body having side surfaces sloping downwardly and outwardly from the top thereof to form a particle impact and distributing surface, and means rigidly supporting said deflector from circumferentially spaced portions of the discharge end of said spout.

2. Apparatus according to claim 1 wherein said fine screen is pivoted at one end and positioned at its opposite end by a strut.

References Cited in the file of this patent

UNITED STATES PATENTS

1,148,331	Olsson	July 27, 1915
1,510,742	Gutleben	Oct. 7, 1924
1,795,348	Schmidt	Mar. 10, 1931
1,916,337	Schmidt	July 4, 1933
2,421,840	Lechthaler et al.	June 10, 1947
2,434,843	Fahnestock et al.	Jan. 20, 1948
2,559,876	Hoekstra	July 10, 1951
2,574,503	Simpson	Nov. 13, 1951
2,665,119	Broman	Jan. 5, 1954
2,684,928	Berg	July 27, 1954
2,750,158	Forkel	June 12, 1956
2,751,211	Begley	June 19, 1956
2,762,610	Puhr-Westerheide	Sept. 11, 1956