Nov. 12, 1940. W. C. ROGERS 2,221,385

SEPARATION OF SOLIDS FROM GASES

Filed Nov. 5, 1938

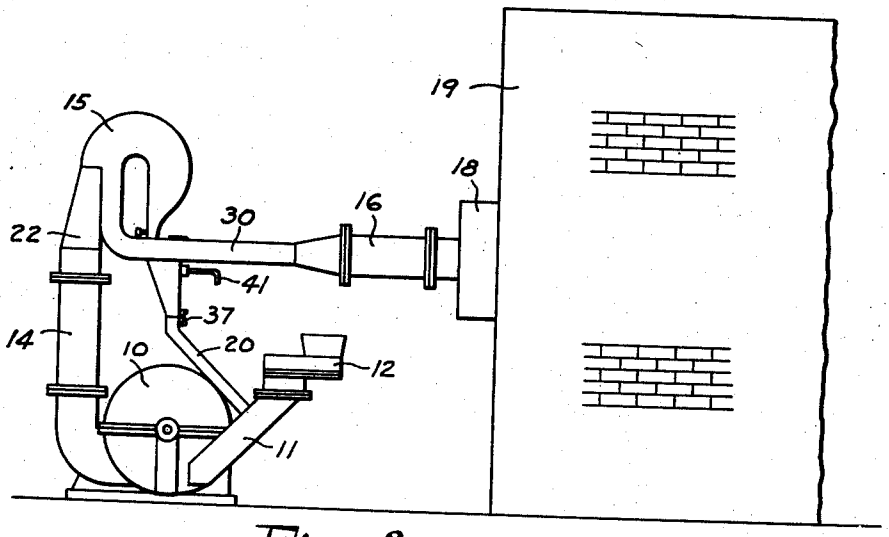

Fig. 3

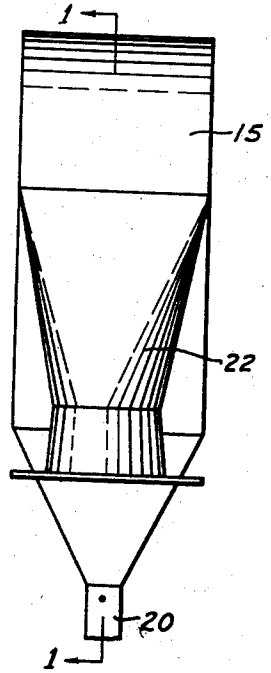

Fig. 2

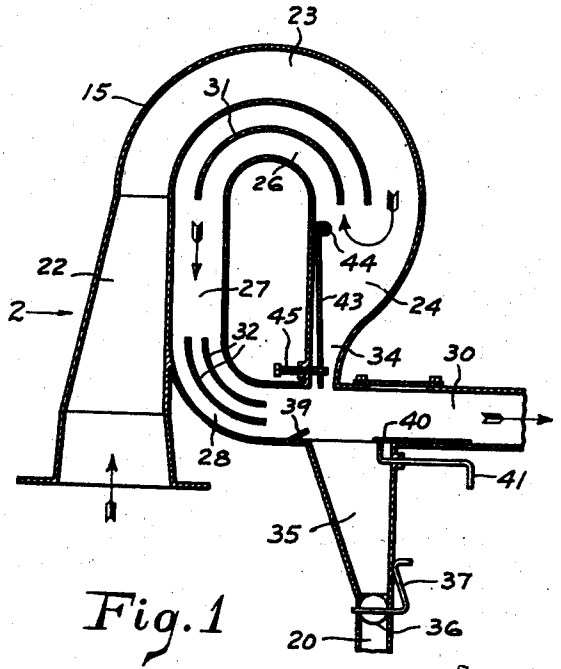

Fig. 1

Inventor

WAYNE C. ROGERS

By Albert G. Blodgett

Attorney

Patented Nov. 12, 1940 2,221,385

UNITED STATES PATENT OFFICE

2,221,385

SEPARATION OF SOLIDS FROM GASES

Wayne C. Rogers, Worcester, Mass., assignor to Riley Stoker Corporation, Worcester, Mass., a corporation of Massachusetts

Application November 5, 1938, Serial No. 239,047

4 Claims. (Cl. 209—143)

This invention relates to the separation of solids from gases, and more particularly to the separation of coarse particles of solid material from a mixture of coarse and fine particles carried in suspension in a gas stream.

In the preparation of pulverized coal for combustion purposes it is customary to utilize a current of air to remove the coal from the pulverizer, and if the system is of the so-called "direct fired" type this air current serves to convey the coal to the furnace burner. The coal as it leaves the pulverizer is never of a uniform size but consists of a mixture of particles of various sizes, some extremely fine and others relatively coarse. By adjusting the pulverizer in such a way as to increase the average size of the coal particles it is possible to reduce the power required to drive the machine and to decrease the wear on the various parts of the machine, but such a procedure has certain disadvantages in that some of the coal particles may be too coarse to burn properly while in suspension in the furnace. It has been proposed to separate these coarse particles from the air stream and to return them to the pulverizer for further grinding. However, it has been found extremely difficult to separate the coarse particles from the fine particles and to avoid returning a considerable proportion of the fine particles to the pulverizer along with the coarse particles.

It is accordingly one object of the invention to provide a simple and efficient apparatus whereby coarse particles of solid material may be removed from a mixture of fine and coarse particles carried in suspension in a gas stream without removing an appreciable portion of the fine particles.

It is a further object of the invention to provide a compact and inexpensive apparatus which will serve to remove the coarse particles of solid material from a mixture of fine and coarse particles carried in suspension in a gas stream and to discharge the gas stream with substantially all of the fine particles carried therewith.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawing illustrating one embodiment of the invention, and in which like reference numerals indicate like parts:

Fig. 1 is a vertical section through an improved classifier constructed in accordance with the invention, the section being taken on the line 1—1 of Fig. 2;

Fig. 2 is an elevation of the classifier as viewed in the direction of the arrow 2 in Fig. 1; and

Fig. 3 is an elevation of the classifier installed in connection with a direct-fired pulverized coal burning system.

Referring first to Fig. 3, I have there shown a pulverizer 10 to which coal is delivered through a feed chute 11 by means of a regulatable feeding mechanism 12. The pulverizer may be of any suitable construction which will serve to deliver a mixture of fine and coarse coal particles in suspension in a stream of air flowing upwardly from the pulverizer through a vertical discharge pipe 14. This pipe 14 leads to a classifier 15 which is connected by a pipe 16 to a burner 18 associated with a furnace 19. A pipe 20 serves to return coarse coal particles from the classifier to the feed chute 11.

As shown particularly in Fig. 1, the classifier 15 comprises walls forming a substantially vertical inlet passage 22 through which the stream of air and coal flows upwardly to a curved passage 23 shaped as an inverted U. At the outlet of the passage 23 there is provided a separating chamber 24 which communicates with the inlet end of a curved passage 26 shaped as an inverted U and located directly beneath the passage 23. From the outlet end of the passage 26 the stream flows downwardly through a vertical passage 27, located adjacent the inlet passage 22, and thence through a right angle bend 28 into a horizontal discharge passage 30 positioned beneath the separating chamber 24. The passage 26 is provided with a partition 31 and the bend 28 is provided with two partitions 32, these partitions extending in the direction of flow to minimize the separation of coal from the air in these parts of the apparatus. The passages 22, 23, 26, 28 and 30 are all located in the same vertical plane.

It will now be clear that the coarse coal particles and a considerable portion of the fine particles will separate from the air by reason of centrifugal force in the curved passage 23 and particularly as the stream turns through 180 degrees just prior to entering the passage 26. These separated particles will be deposited in the separating chamber 24, but before they can be returned to the pulverizer it is important to remove as many of the fine particles as possible, for the further grinding of the fine particles is unnecessary, wasteful of power, and will cause excessive wear on the pulverizer. There is accordingly provided a passage or opening 34 lead-

ing downwardly from the separating chamber 24 and entering the top of the horizontal passage 30, this opening 34 serving to return the separated particles to the air stream with a velocity component transverse to the direction of flow of the air stream. At the bottom of the horizontal passage 30 there is provided a downwardly converging passage or collecting chamber in the form of a hopper 35 which is open to the passage 30 for an appreciable distance downstream from the upper opening 34. The bottom of the hopper 35 is connected to the upper end of the pipe 20 through which the coarse particles are returned to the pulverizer 10. This return pipe 20 is preferably provided with a damper 36 having an operating handle 37. An upwardly projecting lip or deflector 39 is provided at the bottom of the horizontal passage 30 adjacent the upstream edge of the hopper 35 in order to prevent fine particles which pass around the bend 28 from entering the hopper. A horizontal plate 40 is mounted on the bottom of the horizontal passage 30 with its upstream edge slightly overlying the hopper 35, and this plate may be slidably adjusted along the passage by means of a handle 41, thereby varying the horizontal distance from the upper opening 34 to the downstream edge of the hopper opening. Means is preferably provided to adjust the area of the opening 34, and for this purpose I have shown a valve in the form of an upright plate 43 with its lower portion located in this opening and with its upper edge formed with ears 44 which are pivotally connected to the side walls of the separating chamber 24. The lower edge of the plate 43 may be adjusted by means of a screw 45.

The operation of the invention will now be apparent from the above disclosure. The mixture of fine and coarse coal particles is discharged from the pulverizer 10 in a stream of air upwardly through the pipe 14 and passage 22 to the curved passage 23 and the separating chamber 24, whence most of the air and some of the fine particles enter the passage 26. The action of centrifugal force resulting from the change in direction of flow will cause the coarse coal particles and some of the fine particles to separate from the air stream and descend through the chamber 24 and passage 34. The main air stream will continue through the passages 26, 27, 28 and 30 to the pipe 16 and the burner 18. The partitions 31 and 32 will tend to prevent excessive separation of the fine particles from the air stream in the bends 26 and 28, while the lip 39 will deflect upwardly any fine particles which may be traveling along the outer wall of the bend 28 and thus tend to prevent them from entering the hopper 35. The separated coarse and fine particles will enter the horizontal passage 30 through the opening 34 and descend through the air stream because of their entering velocity and the effect of gravity. At the same time these particles will be carried along horizontally by the air stream, but this effect will be more pronounced on the finer particles since the ratio of their surface area to their mass is much higher than in the case of the coarse particles. Accordingly, the coarse particles will descend entirely through the air stream and be collected in the hopper 35, whereas the fine particles will be carried beyond the hopper before they can descend far enough to enter the same. The separated coarse particles are returned to the pulverizer through the pipe 20, with a small amount of air under the control of the damper 36.

By adjusting the plate 43 it is possible to vary the quantity of air following through the opening 34 with the separated particles and thus to some extent control their velocity. By adjusting the plate 40 it is possible to control the classification of the particles, for if this plate is moved downstream there will be more opportunity for the particles to descend through the air stream before they pass beyond the hopper opening, and as a result particles of smaller size will be collected in the hopper without of course affecting the collection of the large size particles.

It will be apparent that I have disclosed a novel apparatus so constructed and arranged that solid particles above a predetermined size may be separated from a gas stream while particles below the said predetermined size are carried along with the stream. This apparatus is simple and compact and particularly suitable for separating coarse solid particles from gas streams which carry a mixture of both coarse and fine particles in suspension.

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

1. An apparatus for separating solids from gases comprising a substantially horizontal passage, a gas passage shaped to conduct the inflowing gas stream in a curved path and thence to the horizontal passage, means to deliver into the upper portion of the said horizontal passage such of the solid particles as are separated from the gas by centrifugal action as the gas flows in said curved path, a collecting chamber located beneath the horizontal passage and having an opening thereto which extends downstream beyond the point at which the particles are returned to the stream, and a device adjustable longitudinally of the horizontal passage and arranged to form the downstream boundary of the said opening.

2. An apparatus for separating solids from gases comprising a substantially horizontal passage, a gas passage shaped to conduct the inflowing gas stream in a curved path and thence to the horizontal passage, means to deliver into the upper portion of the said horizontal passage such of the solid particles as are separated from the gas by centrifugal action as the gas flows in said curved path, a collecting chamber located beneath the horizontal passage and having an opening thereto which extends downstream beyond the point at which the particles are returned to the stream, and a device located at the bottom of the horizontal passage upstream from the collecting chamber and arranged to deflect fine particles upwardly to prevent them from entering the collecting chamber.

3. An apparatus for separating solids from gases comprising a gas passage shaped as an inverted U, means to deliver to one end of said passage a stream of gas with solid particles suspended therein, a second gas passage shaped as an inverted U located directly beneath the first passage, a separating chamber through which the gas flows from the outlet end of the first passage into the adjacent end of the second passage, a passage leading downwardly from the outlet end of the second passage and thence substantially horizontally beneath the separating chamber, a passage leading directly downward from the separating chamber to the horizontal passage therebeneath, and a collecting chamber located beneath the horizontal passage and having an open-

ing thereto which extends downstream beyond the delivery end of the passage leading from the separating chamber.

4. An apparatus for separating solids from gases comprising a separating chamber, a gas outlet passage communicating with the separating chamber and shaped as an inverted U, means to deliver a stream of gas with solid particles suspended therein downwardly into the separating chamber, the gas stream turning upwardly in the separating chamber and thence entering one end of the said gas passage, a second passage leading downwardly from the other end of the said gas passage and thence beneath the separating chamber, a passage leading directly downward from the separating chamber to the passage therebeneath, and a collecting chamber located beneath the said second passage and having an opening thereto which extends downstream beyond the delivery end of the passage leading from the separating chamber.

WAYNE C. ROGERS.