The present invention relates to reducing fluidizers and the method of fluidizing.

Among the objects of the invention is to provide a novel method of fluidizing or reducing material to a fine state by the energy of a high velocity stream of fluid acting upon the surface of a bed or body of material and novel means whereby such method may be effected.

Another object is to provide such novel method and means for effecting the reduction of the material in a circuitous path or passage from which the incompletely reduced particles are returned for re-reduction, and the stream of fluid and entrained particles are diverted or deflect into a separating means for the separation of the finer from the coarser and heavier particles, the fluid with the fines being conducted, with or without the use of a regulatable by-pass, to a place of use, collection, storage or the like, the by-pass being used to return said fluid to the fluid forcing means for re-use. The course of the actuating fluid may be deflected with the entrained particles for the separation of the incompletely reduced particles, and the bed of material held from bodily movement by a-retarding or anchoring means for holding a part of the bed in place when acted upon.

Feeding of the material may be effected by suitable feeding means for maintaining the bed to the proper amount or mass for proper action thereon by the fluid stream.

Other objects, advantages, capabilities and features are comprehended by the invention as will later appear and are inherently possessed thereby.

Referring to the drawings, Fig. 1 is a view partly in vertical section and partly in vertical elevation of a device constructed in accordance with the invention; Fig. 2 is a fragmentary vertical section taken in a plane represented by line 2—2 in Fig. 1 of the drawings; Fig. 3 is a horizontal sectional view taken through a separating means, in a plane represented by line 3—3 in Fig. 1 of the drawings; Fig. 4 is a fragmentary perspective view of a means for regulating the actuating fluid stream; Fig. 5 is a view similar to Fig. 1 showing an alternate form of separating means partly in section and partly in vertical elevation; and Fig. 6 is a horizontal sectional view taken in a plane represented by line 6—6 in Fig. 5 of the drawings.

Referring now more in detail to the drawings, the embodiments selected to illustrate the invention are shown as comprising a chamber 1 in the lower part of which is located a bed of material 2 which may be maintained in a predetermined or given amount by supply of material from a hopper 3 located at the side of the chamber 1, and having therein a suitable feeding device 4 which may be operated in any suitable manner. The feeding device is preferably located in the outlet 5 of the hopper. Within the chamber 1 is provided a closed inner chamber 2 extending transversely through the casing of the machine so as to provide around the chamber 2 a passage 6 of circuitous form, the chamber 2 being tapered or in the form of a dihedral angle at the side where the material is introduced, and having a rounded or part cylindrical portion 7 spaced from a curved portion 8 of the casing, and a corrugated or ribbed retard means such as a plate 9 as clearly shown in the drawings.

Beneath the hopper is provided a passage 10 extending inwardly into the lower part of the casing, and having a nozzle 11 at the upper part of which is a gate or control valve 12 connected to a transverse shaft 13 extending to the exterior of the material and adapted to be operated by any suitable means for raising and lowering the valve and controlling the size of the orifice 14 of the nozzle 11.

The upper part of the chamber communicates with a separating chamber 15 in the upper part of which is located a separating means comprising a circular series of vanes 16, which in the form shown in Fig. 1, are inclined to the axis of the device and located between a plate 17 and a ring 18 and secured thereto. To the plate 17 is secured a rod 19 which extends upwardly through the top wall 20 of an exit or outlet passage 21, the rod 19 being provided with a plurality of apertures 22 to which may extend, selectively, a pin 23 for holding the rod in any given de-
sired height, clearly as shown in Fig. 1 of the drawings.  
The outlet 21 is connected at one side with a duct or passage 24 adapted for conveying the fluid and suspended fine material to a place of use, collection, storage or the like. On the opposite side of the member 21 may also be connected a by-pass section or duct 25 and a duct 26 leading back to the passage 10, the duct part 26 having a control valve 27 for regulating the by-passage of fluid for return to the passage 10.  

In Fig. 3, the construction is similar to that described in connection with Figs. 1, 2, 3 and 4 with the exception that the separating means comprises a circular series of vanes 28 disposed substantially parallel to the axis of the device, and connected between plates 29 and 30. To the plate 29 the rod 10 is connected, which rod has the perforations 22 for the selective engagement therewith of the pin 23 for the holding of the separating means at given vertical height. Within the chamber 15 is also placed a hollow cone 31 having the small end thereof extending downwardly at or beneath the lower part of the separating vane device 28. The vanes 28 are of curved form as shown in Fig. 6 of the drawings.  

In the operation of the device, the feeding device 4 acts to maintain a bed of material 2 in the lower part of the chamber 1, so that additional material may be supplied from the hopper 3 to the said bed of material, and thus maintain an approximately given amount therein, i.e., so as to replace the material which is removed by the fluid stream. A fluid, such as air, is supplied under high pressure through the passage 10 and projected from the nozzle 11 in the form of a stream at high velocity into the circuitous passage 6, beneath the hollow chamber 2 so as to cause the same to act upon the surface of the bed, and to pass upwardly between the rounded part 7 of the chamber 2 and the retarding means 9. This will cause an entraining of particles of material from the surface of the bed and the passing upwardly of the entrained material into the upper part of the chamber 1, the material taking a more or less circuitous movement. As the fluid and material is deflected by passing between the rounded part 7 and the retarding means 9, and pass into the space of the upper part of the chamber 1, gravity will cause the heavier particles to drop out and course down the inclined surface of the tapered part of the chamber 1, and to be united with the material being fed to the bed from the feeding means, for re-reduction. These last mentioned particles will be again engaged by the stream issuing from the nozzle and be projected against the surface of the fluid bed whereby impacting of particle upon particle will act to reduce the same. The effect of the fluid stream is to cause transverse stresses to the moving layers of the material particles, whereby the inner layer of the circuitous path will move at a greater rate than the outer layer and will cause the layers to rub one upon the other with sufficient destructive force as to cause particles to press against particles and reduce the same.  

The mixture of the fluid and entrained particles projected into the upper part of the chamber 1, will proceed upwardly into the chamber 15 and pass through the spaces between the vanes 10 of the separating means, or the vanes 28 of the separating means shown in Fig. 5. The height of the separating means will control the fineness of the particles that will be carried upwardly into the outlet 21. The coarser or heavier particles will be caused to travel downwardly into the chamber 15 and toward the feeding means to be reunited with the material being fed to the bed. The fluid with the fines will then pass through the duct 24 to the place of use, collection, storage or the like. In one use of the device, sufficient fluid is used to mix with sufficient fine particles to make a combustible mixture of fuel whereby the same may be burned in a combustion chamber of a furnace. Where an amount of fluid is used in excess to that necessary to make a combustible mixture, the excess fluid may be passed back through the by-pass so as to be again used with the incoming fluid passing through the passage 10. This may be controlled by the valve 27, as desired.  

The stream may be regulated by operation of the valve 12 so as to increase the volume or decrease the same in accordance with the desired action upon the material within the lower part of the machine. The retard member 9 will act to prevent a bodily movement of the material around the chamber 2, thus anchoring or holding the main portion of the bed in place whereby the stream or fluid may act upon the surface thereof as above described. By means of the adjustable air inlet nozzle, a desired velocity, such as twenty thousand pounds per minute can be maintained at any rating up to the capacity of the equipment. When, however, operation is made with lower velocities using more fluid than required for supplying the fines to the point of use, the by-pass may then be used for returning the excess fluid as above stated.  

While I have herein described and upon the drawings shown illustrative embodiments of the invention, it is to be understood that the latter is not limited thereto, but may comprehend other constructions, details, arrangements of parts and features without departing from the spirit thereof.  

Having thus disclosed the invention, I claim:  
1. A method of pulverizing material comprising providing a normally stationary bed of the material and passing a fluid stream through the bed to cause the material to be reduced in size, the fluid stream being in excess of the amount necessary for making a combustible mixture of fuel whereby the same is burned in a combustion chamber of a furnace, the excess fluid being passed back through the by-pass so as to be again used with the incoming fluid, the fluid and the fines being passed through the spaces between vanes of the separating means, and the height of the separating means controlling the fineness of the particles that are carried upwardly.
of material, forcing a stream of fluid at high velocity over the surface of said bed of material, so that particles of said material will be entrained by said stream, and the entrained particles will be caused to impact against the said surface and against each other, and supplying additional material to said bed as the entrained particles are removed therefrom.

2. A method of pulverizing material comprising providing a normally stationary bed of material, forcing a stream of fluid at high velocity over the surface of said bed of material, so that particles of said material will be entrained by said stream, and the entrained particles will be caused to impact against the said surface and against each other, and supplying additional material to said bed as the entrained particles are removed therefrom, and deflecting the stream and entrained particles of material for separation of large and heavy particles.

3. A method of pulverizing material comprising providing a normally stationary bed of material, forcing a stream of fluid at high velocity over the surface of said bed of material, so that particles of said material will be entrained by said stream, and the entrained particles will be caused to impact against the said surface and against each other, and supplying additional material to said bed as the entrained particles are removed therefrom, and deflecting the stream and entrained particles of material for separation of large and heavy particles, and returning the separated larger and heavier particles to said bed for further reduction.

4. A method of pulverizing material comprising producing a normally stationary bed of material, forcing a stream of fluid at high velocity over the surface of said bed of material so that said material will be entrained by said stream, and the entrained particles will be caused to impact against the said surface and against each other, and supplying additional material to said bed at a given rate so as to maintain an approximately constant volume of material in the bed.

5. A method of pulverizing material comprising producing a normally stationary bed of material, forcing a stream of fluid at high velocity over the surface of said bed of material so that particles of said material will be entrained by said stream, and the entrained particles will be caused to impact against the said surface and against each other, deflecting the stream and entrained particles of material for separation of the larger and heavier particles, whirling the stream and entrained particles for separating the finer from the coarser particles, and supplying additional material to said bed as the entrained particles are removed therefrom.

6. A method of pulverizing material comprising producing a normally stationary bed of material, forcing a stream of fluid at high velocity over the surface of said bed of material so that particles of said material will be entrained by said stream, and the entrained particles will be caused to impact against the said surface and against each other, retarding the movement of a part of the entrained material, and supplying additional material to said bed as the entrained particles are removed.

7. A method of pulverizing material comprising producing a normally stationary bed of material, forcing a stream of fluid at high velocity over the surface of said bed of material so that particles of said material will be entrained by said stream, and the entrained particles will be caused to impact against the said surface and against each other, retarding the movement of a part of the entrained material, creating transverse stresses in said stream and entrained material for reducing the particles thereof, and supplying additional material to the bed as the entrained particles are removed therefrom.

8. A method of pulverizing material comprising producing a normally stationary bed of material, forcing a stream of fluid at high velocity over the surface of said bed of material so that particles of said material will be entrained by said stream, and the entrained particles will be caused to impact against the said surface and against each other, retarding the movement of a part of said entrained material, deflecting the fluid stream and entrained particles of material as they are retarded so as to cause transverse stresses in said deflecting stream for reducing the particles entrained therein, and supplying additional material to said bed as the entrained particles are removed.

9. A method of pulverizing material comprising producing a normally stationary bed of material, applying the energy of a high velocity stream of fluid over the surface of said bed so that particles of said material will be entrained by said stream and the entrained particles will be caused to impact against the said surface and against each other, causing said stream and entrained material to take a circuitous path deflecting a part of the stream and entrained particles from said circuitous path, and supplying additional material to said bed as the entrained particles are removed therefrom.

10. A method of pulverizing material comprising providing a normally stationary bed of material, forcing a high velocity stream of fluid into a circuitous path about a horizontal axis and over the surface of said bed of material so that particles of the material will be entrained by the stream and the entrained particles will be caused to impact against the said surface and against each other, deflecting a part of said fluid stream...
and the entrained particles from said circuitous path, returning the larger and heavier particles to said bed for further reduction, and supplying additional material to said bed as the entrained particles are removed therefrom.

11. A fluidizer of the character described comprising a chamber having means for providing a normally stationary bed of material, means for forcing a stream of fluid at high velocity over the surface of said bed of material so as to entrain particles of said material and causing said particles to impact against said surface and against each other, and means for supplying additional material to said bed as the entrained particles are removed therefrom.

12. A fluidizer of the character described comprising a chamber having means for providing a normally stationary bed of material, means for forcing a stream of fluid at high velocity over the surface of said bed of material so as to entrain particles of said material and causing said particles to impact against said surface and against each other, means for supplying additional material to said bed as the entrained particles are removed therefrom, and means for regulating the energy of said fluid stream.

13. A fluidizer of the character described comprising a chamber having means for providing a normally stationary bed of material, means for forcing a stream of fluid at high velocity over the surface of said bed of material so as to entrain particles of said material and causing said particles to impact against said surface and against each other, means for supplying additional material to said bed as the entrained particles are removed therefrom, means for regulating the energy of said fluid stream, and retarding means for holding said bed of material against bodily movement.

14. A fluidizer comprising a chamber provided with a circuitous passage having a part thereof open to said chamber, means for providing a normally stationary bed of material in said passage, means for forcing a stream of fluid at high velocity over the surface of said bed of material so as to entrain particles of the material and to cause the entrained particles to impact against said surface and against each other, and, means for supplying additional material to said bed as the entrained particles are removed therefrom.

15. A fluidizer comprising a chamber provided with a circuitous passage having a part thereof open to said chamber, means for providing a normally stationary bed of material in said passage, means for forcing a stream of fluid at high velocity over the surface of said bed of material so as to entrain particles of the material and to cause the entrained particles to impact against said surface and against each other, means for supplying additional material to said bed as the entrained particles are removed therefrom, and means for regulating the energy of said fluid stream.

16. A fluidizer comprising a chamber provided with a circuitous passage having a part thereof open to said chamber, means for providing a normally stationary bed of material in said passage, means for forcing a stream of fluid at high velocity over the surface of said bed of material so as to entrain particles of the material and to cause the entrained particles to impact against said surface and against each other, means for supplying additional material to said bed as the entrained particles are removed therefrom, and means for regulating the energy of said fluid stream.

17. A fluidizer comprising a chamber provided with a circuitous passage having a part thereof open to said chamber, means for providing a normally stationary bed of material in said passage, means for forcing a stream of fluid at high velocity over the surface of said bed of material so as to entrain particles of the material and to cause the entrained particles to impact against said surface and against each other, means for supplying additional material to said bed as the entrained particles are removed therefrom, means in said chamber for separating the finer from the coarser and heavier particles and for returning the last mentioned particles to said bed, and means for conducting the finer material with the fluid to a place of use.

18. A fluidizer comprising a chamber provided with a circuitous passage having a part thereof open to said chamber, means for providing a normally stationary bed of material in said passage, means for forcing a stream of fluid at high velocity over the surface of said bed of material so as to entrain particles of the material and to cause the entrained particles to impact against said surface and against each other, means for supplying additional material to said bed as the entrained particles are removed therefrom, means in said chamber for separating the finer from the coarser and heavier particles and for returning the last mentioned particles to said bed, and means for conducting the finer material with the fluid to a place of use, and a by-pass between said conducting means and said fluid-stream-forcing means for returning part of the fluid conducted from said separating means.

19. A fluidizer comprising a chamber provided with a circuitous passage having a part thereof open to said chamber, means for providing a normally stationary bed of material in said passage, means for forcing a stream of fluid at high velocity over the surface of said bed of material so as to entrain particles of the material and to cause the entrained particles to impact against said surface and against each other, means for supplying additional material to said bed as the entrained particles are removed therefrom, and means for regulating the energy of said fluid stream.
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In witness whereof, I hereunto subscribe
my name to this specification.

HENRY G. LYKKEN.