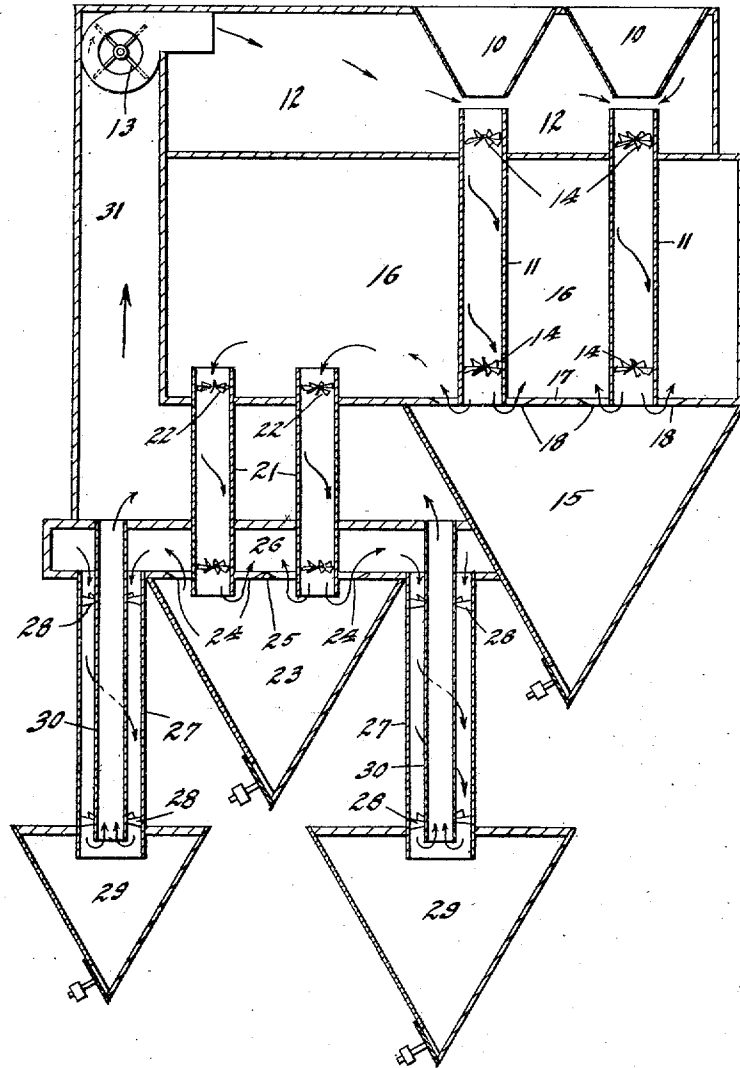


L. N. MORSCHER.
GRADER.
APPLICATION FILED OCT. 19, 1908.

956,817.

Patented May 3, 1910.



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GRADER.

956,817.

Specification of Letters Patent.

Patented May 3, 1910.

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To all whom it may concern:

Be it known that I, LAWRENCE N. MORSCHER, a citizen of the United States, residing at Lawrence, in the county of Douglas and State of Kansas, have invented certain new and useful Improvements in Graders, of which the following is a specification.

The object of my invention is to produce an apparatus for separating into various grades such granular material as is met with in various milling processes, the grading and cleaning of grains, the grading of various sands and gravels and ores, either natural or manufactured, cement, gypsum, and, in fact, any comminuted materials either of the same specific gravity but differing in size, or materials of the same size but differing in specific gravity, the apparatus making use of the power of fluid current to deflect to differing degrees projectiles differing in mass hurled across spaces traversed by said fluid current.

In describing my invention I have used the term "fluid" in view of the fact that, in grading heavy sands, gravels, ores and material of like nature it will often be desirable to use water or some other similar liquid for the deflecting fluid stream, while in grading finely comminuted material which must be kept dry, such as flour, middlings, cement, etc., air or some other gaseous fluid must be used. The theory of operation is the same in all cases.

In order to render the grading of the apparatus independent of absolute velocities within wide limits of variation, and in order to increase the capacity of a given size machine, I find it necessary to comparatively reduce the effect of gravity upon the particles during the processes of grading to such small percentage of the effect of the other forces utilized that the force of gravity may be dropped out of consideration as it does not appreciably affect the result. In explanation of this last statement it is to be noted that the transporting, as well as the lifting, power of a fluid current varies as the sixth power of the velocity, if the transporting power be reckoned by the weight of the particle which the fluid current must either move or lift, since the force with which it will act on two particles having equal surfaces is as the square of the velocity; that is, if the velocity of the fluid current be increased n times, the force will be increased n^2

times but it will then lift a particle having a volume n^3 times the original volume. Therefore, a variation of n times the velocity of the fluid current will cause a variation of n^2 in the diameter, or n^3 in weight, of particles deflected.

The inertia of a projectile being one-half mv^2 , the force required to accelerate or retard this velocity a given percentage in a given distance, or any component of its velocity will therefore be proportionately to the square of the velocity so that, if the ratio of the velocity of the fluid current to that of the projectile be kept constant, and the direction of projection be uniform, the amount of deflection of any given particle will be the same in a given space regardless of the variations of absolute velocity. In my apparatus therefore I cause the particles to be projected across the space at a velocity very much greater than they could possibly attain falling from rest through the same distance, and I then give the deflecting fluid current a deflecting force which, if directed upward, would be much more than sufficient to lift the heaviest particles under treatment. By this combination of high velocities of particle and deflecting current the effect of gravity upon the particles, while it does not vary with the variation of the proportionally non-varying separating forces, is so small a percentage of the total effect upon the particles that the gravity force is practically negligible. As a consequence it will be noted that, though the drawing shows a vertically arranged apparatus yet, nevertheless, so far as the actual operation is concerned the apparatus might just as well be horizontal, the only advantage of the vertical arrangement being ease of removal of the separated particles.

In the drawing, 10 indicates a hopper which is kept filled with the material to be graded and this hopper discharges in a continuous stream of desired size into a tube the receiving end of which lies a sufficient distance from the discharge end of the hopper to form a passage through which air or any other desirable fluid stream may be introduced from the chamber 12 into the tube 11, this current, in the present apparatus, being an air current established by a suitable fan or blower 13. In order to cause the particles in the fluid stream to assume a position on the outside of the stream thus form-

ing a thin envelop of particles for the fluid stream, which envelop proceeds with the fluid stream at substantially the velocity of the fluid stream, some suitable means needs to be arranged in the tube to produce helical movement of the stream. Any suitable apparatus for this purpose may be provided, as for instance a plurality of deflecting blades 14 arranged within the tube and serving to set the stream into a helical path, thus causing the particles, which of necessity must be of a greater specific weight than the fluid stream, to be immediately hurled to the inner wall of the tube and proceed along said wall as an envelop to the fluid stream. The discharge end of tube 11 leads into a receiving chamber 15 which is separated from the forwarding chamber 16 by a suitable partition 17 having an opening 18 therein which forms a communication between the receiving chamber 15 and the forwarding chamber 16, the position of said opening relative to the discharge end of the tube determining the character of separation. The suction side of the fan 13 is connected, in a manner to be hereafter described, with the forwarding chamber 16 so that there is a continuous fluid current through the parts and the operation of the apparatus thus far described is as follows:

When the fluid stream, with its envelop of particles, reaches the discharge end of tube 11, the inertia of the particles causes them to proceed normally in a trajectory which is a forwardly inclined tangent to the discharge end of tube 11 so that the complete trajectory of all of the particles would have the appearance of a hyperbola of revolution. The chamber 15, however, so far as the fluid current is concerned is a dead chamber and the fan 13 draws the oncoming fluid current backwardly through the opening 18, but, as the fluid current is enveloped by the stream of particles the fluid current must traverse the particle envelop transversely and, its velocity affecting the particles directly as the surfaces thereof and inversely as their masses, the particles of less mass will be deflected to a greater extent and those of a mass less than the mass of differentiation will pass back through the opening 18 and into the forwarding chamber 16, while those particles of a mass greater than the mass of differentiation will pass onward into the collecting chamber 15 and out of, and entirely beyond the influence of, the carrying current. The velocities may be readily made so much greater than the free falling velocity produced by gravity (within the space of the apparatus) upon the particles that the force of gravity will have practically no material effect upon the operation of the apparatus.

If a single grading, *i. e.* into two quantities is all that is desired the apparatus al-

ready defined is sufficient but if further grading is desired the particle-laden fluid stream from the forwarding chamber 16 may be carried through other tubes 21 like the tubes 11 and equipped with stream deflectors 22. The tubes 21 discharge into the collecting chamber 23 and the discharge ends of said tubes are arranged in relation to openings 24 formed in a partition 25 so that said openings will serve as a separator like the openings 18. The deflected fluid stream, with the particles which may still be retained therein, will pass through the openings 24 into a forwarding chamber 26 and from thence pass through tubes 27 having deflectors 28 arranged therein. The tubes 27 are provided for a final separation of all remaining particles from the fluid stream and therefore provision needs to be made to extract the fluid stream from the interior of the particle envelop instead of causing said fluid stream to traverse the envelop transversely as heretofore described. Consequently the tube 27 at its discharge end leads into a final collecting chamber 29. Arranged inside of the tube 27 is an extracting tube 30 the receiving end of which lies inside of the discharge end of tube 27 and the discharge end of which communicates through a duct or chamber 31 with fan 13 so that, when the fluid stream with its envelop of particles nears the discharge end of tube 27, the particle envelop will be projected into the chamber 29 while the fluid stream will be extracted therefrom by a reversal of its direction and a movement rearwardly through tube 30 to the fan 13.

I claim as my invention:

1. The combination, with a stream-defining conduit and means associated therewith for producing a helical movement of the stream whereby particles suspended in the stream will form an envelop for the fluid stream, of a closed receiving chamber into which the delivery end of the conduit is projected, said receiving chamber having an outlet opening surrounding the delivery end of the conduit behind the same, and means for causing the flow of a particle-laden fluid stream through said conduit and said outlet opening, for the purpose set forth.

2. The combination, with a stream-defining conduit and deflectors arranged therein for producing a helical movement of the stream whereby particles suspended in the stream will form an envelop for the fluid stream, of a closed receiving chamber into which the delivery end of the conduit is projected, said receiving chamber having an outlet opening surrounding the delivery end of the conduit behind the same, and means for causing the flow of a particle-laden fluid stream through said conduit and said outlet opening for the purpose set forth.

3. The combination, with a stream-defin-

ing conduit and means associated therewith
for producing a helical movement of the
stream whereby particles suspended in the
stream will form an envelop for the fluid
5 stream, of a closed receiving chamber into
which the delivery end of the conduit is pro-
jected, said receiving chamber having an
outlet opening surrounding the delivery end
of the conduit behind the same, a second
10 stream-defining conduit, arranged to receive
the material passing through said outlet
from the receiving chamber, means associ-
ated therewith for producing a helical move-
ment of the stream therein whereby particles
15 suspended in the stream will form an en-
velop for the fluid stream, a second closed
receiving chamber into which the delivery
end of said second conduit is projected, an
extraction conduit arranged centrally with-
20 in the said second stream-defining conduit
with its inner end inside of the discharge
end of said second conduit, and means for es-
tablishing fluid currents through said con-
duits.

25 4. The combination, with a stream-defin-
ing conduit and deflectors arranged therein
for producing a helical movement of the
stream whereby particles suspended in the
stream will form an envelop for the fluid
30 stream, of a closed receiving chamber into
which the delivery end of the conduit is pro-
jected, said receiving chamber having an
outlet opening surrounding the delivery end
of the conduit behind the same, a second

stream-defining conduit arranged to receive 35
the material passing through said outlet
from the receiving chamber, means associ-
ated therewith for producing a helical move-
ment of the stream therein whereby particles
suspended in the stream will form an envelop 40
for the fluid stream, a second closed re-
ceiving chamber into which the delivery end
of said second conduit is projected, an
extraction conduit arranged centrally with-
in the said second stream-defining conduit 45
with its inner end inside of the discharge
end of said second conduit, and means for es-
tablishing fluid currents through said con-
duits.

5. The combination, with a stream-defin- 50
ing conduit, of a closed receiving chamber
into which said conduit is projected, an ex-
traction conduit arranged centrally within
the first mentioned conduit with its inner
end inside of the discharge end of the first 55
mentioned conduit, means associated with
said first mentioned conduit for producing a
helical movement of the stream in said con-
duit, and means for producing fluid cur-
rents in said conduits. 60

In witness whereof, I, have hereunto set
my hand and seal at Indianapolis, Indiana,
this sixth day of October, A. D. one thou-
sand nine hundred and eight.

LAWRENCE N. MORSCHER. [L. S.]

Witnesses:

ARTHUR M. HOOD,
THOMAS W. McMEANS.