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ARRANGEMENT FOR THE EQUAL DISTRIBUTION OF THE THROUGHPUT OF A MIXTURE OF SOLIDS AND FLUIDS IN A VERTICAL PIPE

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Fig. 1

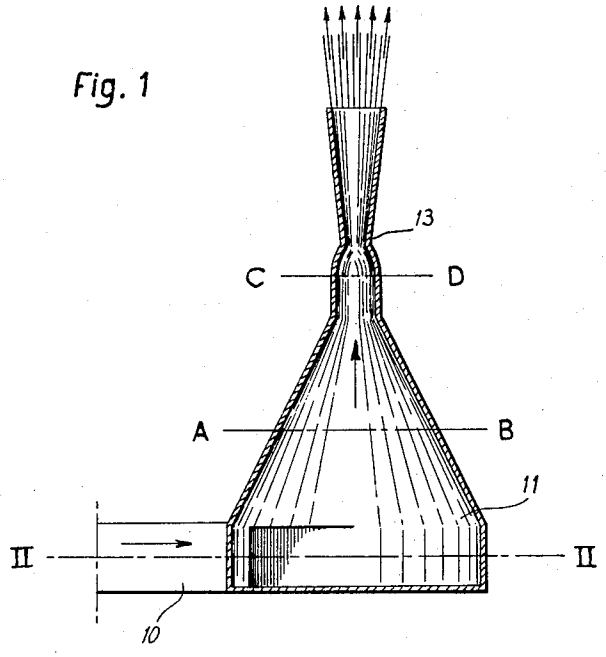


Fig. 2

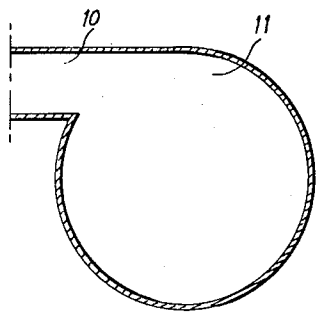
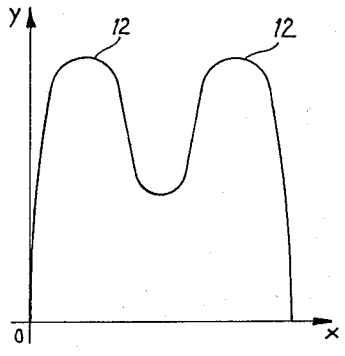


Fig. 3



Inventors
Bernard Trentini and
Georges Cohen de Lara
By Michael S. Striker
Attorney.

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ARRANGEMENT FOR THE EQUAL DISTRIBUTION OF THE THROUGHPUT OF A MIXTURE OF SOLIDS AND FLUIDS IN A VERTICAL PIPE

Bernard Trentini, St. Germain-en-Laye, and Georges Cohen de Lara, Grenoble, France, assignors to Institut de Recherches de la Siderurgie, Saint Germain-en-Laye, a professional institution of France, and Societe Grenobloise d'Etudes et d'Applications Hydrauliques, Société Anonyme, Grenoble, France, a French company

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It is often desired to distribute uniformly a compound solid and fluid throughput flowing through a pipe system, between several tuyères connected with a single feed circuit.

Thus, in the case of the blowing of pulverulent materials through tuyères into a metallurgical container, such as a ladle, difficulties are met when it is attempted to obtain a uniform distribution of said pulverulent material in the different tuyères, which may lead to a clogging and reduces the grade of the stirring. It is a well-known fact that in a horizontal flow of a fluid carrying solid particles along with it, there exists a gradient of the concentrations in each transverse cross-section of the pipe, the higher concentrations being found in the vicinity of the lower generating lines and the lower concentrations in the vicinity of the upper generating lines. It is furthermore known that a vertical pipe of a sufficient length allows obtaining a sufficiently uniform distribution of the solid particles in a carrier fluid.

Unfortunately, this latter arrangement is not always applicable for obvious reasons of bulk and of location and it is often impossible to provide rectilinear sections the length of which is sufficient for obtaining a uniform distribution of the solid and fluid throughputs. Furthermore, it should be observed that the bend which is required for connecting the horizontal section of a conveyor with a vertical section such as that referred to, has a very marked action on the distribution of the solid particles in the vertical feed section.

The main object of our invention is to solve these difficulties through an arrangement which allows obtaining a uniform distribution of the solid and fluid throughputs in a pipe system whenever this distribution would be otherwise imperfect as a consequence of the manner of feeding the solid and fluid material, or its uniformity has been destroyed during horizontal flow under the action of gravity and friction.

Another object of our invention is to provide an arrangement for obtaining the uniform distribution of a throughput of a mixture of solids and fluids inside a vertical pipe of a comparatively reduced length.

In order to allow our invention to be better understood and by way of an example which should not be construed in a limiting sense, we will now describe, reference being made to the accompanying drawings, a preferred embodiment of said invention. In said drawings:

Fig. 1 is a diagrammatic vertical sectional showing of an arrangement according to our invention.

Fig. 2 is a cross-section through line II—II of Fig. 1, and Fig. 3 shows the curve illustrating the concentrations per unit of surface in a horizontal section A—B of Fig. 1.

As illustrated in Figs. 1 and 2, the mixture of solid and fluid material conveyed inside a horizontal pipe **10** opens tangentially into the body of the cyclone **11** in which the flow of solid and fluid material is transformed as a consequence of centrifugal action into a generally

vertical flow which is perpendicular to the first part of the flow in the horizontal pipe **10**.

The curve showing the distribution of the concentrations of the throughput of solid materials in the horizontal cross-section A—B of the cyclone is illustrated in Fig. 3, the concentrations being shown as ordinates y, while the distances starting from a point of the wall of the cyclone along a horizontal diameter are shown as abscissae x. By reason of the convergent action of the cyclone wall, the centrifugal action increases and the concentration peaks **12** become closer to each other, while their intensity increases in the successive higher cross-sections.

The distribution of the solid and fluid throughputs is clearly improved at the level C—D in the cyclone with reference to the usual arrangement proposed, which resorts to a vertical pipe, the height of which is substantially equal to that of the cyclone.

However, the uniform distribution of the solid and fluid throughputs obtained precedingly may be still further improved by providing on the down stream end of the cyclone **11** a convergent and divergent pipe member **13** designed in a manner such that its convergence may be comparatively large while its divergence is very small. Furthermore, the divergent section should be sufficiently long for the area of its terminal downstream cross-section to be approximately equal to the total utilization area.

Consequently, the device according to the invention comprises a vertical cyclone, combined with a convergent and divergent member, the convergent section of which is very short and shows a large apical angle.

At the level of this terminal cross-section, we may arrange tuyères the total cross-section of which should not be very different from that of the said terminal cross-section, in order to cut any disturbances in the flow.

The results of tests executed by the Laboratoires Dauphinois d'Hydraulique show that this arrangement designed in accordance with our invention allows obtaining an excellent and uniform distribution of the solid and fluid throughputs through the tuyères arranged at the downstream end of the main circuit.

In practice, it has been found before and after the introduction of our improved apparatus a clear reduction in the dispersion of the flow and the ratio between the minimum and maximum throughputs has dropped from 1:10 to 1:1.15.

On the other hand, the application of our invention to the treatment of liquid cast iron through a pulverulent substance with a view to removing the sulphur has led to highly satisfactory results.

What we claim is:

1. An arrangement for homogenizing a flowing mixture of a metallurgically useful powdered material and a fluid, comprising, in combination, a frusto-conically shaped hollow member vertically disposed so that the apex portion of the same is at the top, said frusto-conically shaped hollow member defining a free and unobstructed inner space; a substantially horizontally positioned inlet tube, tangentially entering the base of said frusto-conically shaped hollow member; a vertical tubular extension located on the top of and communicating with said frusto-conically shaped hollow member and having a converging top portion terminating in an aperture having a wide apical angle; and a divergent vertical outlet tube located on top of said vertical tubular extension and communicating with said aperture in said converging top portion thereof.

2. An arrangement for homogenizing a flowing mixture of a metallurgically useful powdered material and a fluid, comprising, in combination, a frusto-conically shaped hollow member vertically disposed so that the apex portion of the same is at the top, said frusto-coni-

cally shaped hollow member defining a free and unobstructed inner space; a substantially horizontally positioned inlet tube, tangentially entering the base of said frusto-conically shaped hollow member; a vertical cylindrical extension located on the top of and communicating with said frusto-conically shaped hollow member and having a converging top portion terminating in an aperture having a wide apical angle; and a divergent vertical outlet tube located on top of said vertical tubular extension and communicating with said aperture in said converging top portion thereof.

3. An arrangement for homogenizing a flowing mixture of a metallurgically useful pulverulent material and a fluid, comprising, in combination, a frusto-conically shaped hollow member having its central axis vertically disposed so that the apex portion of the same is at the top, said frusto-conically shaped hollow member defining a free and unobstructed inner space; a substantially horizontally positioned inlet tube, tangentially entering the base of said frusto-conically shaped hollow member; a vertical tubular extension located on the top of and communicating with said frusto-conically shaped hollow member and having a converging top portion terminating in an aperture having a wide apical angle; and a divergent vertical outlet tube located on top of said vertical tubular extension and communicating with said aperture in said converging top portion thereof, said vertical tubular extension and said vertical outlet tube arranged coaxially with said frusto-conically shaped hollow member.

4. An arrangement for homogenizing a flowing mixture of a metallurgically useful powdered material and a fluid comprising, in combination, a frusto-conically shaped hollow member vertically disposed so that the apex portion thereof is at the top, said frusto-conically shaped hollow member defining a free and unobstructed inner space; a substantially horizontally positioned inlet tube tangentially entering the base of said frusto-conically shaped hollow member; a vertical tubular extension coaxial with said frusto-conically shaped hollow member, projecting from the top and communicating with the interior thereof and having a converging top portion terminating in an aperture having a wide apical angle; and a divergent vertical outlet tube located on top of said vertical tubular extension and coaxial therewith and communicating with said aperture at said converging top portion thereof, said divergent vertical outlet tube being longer than said tubular extension and having an apex angle considerably smaller than said apical angle of said aperture.

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