July 6, 1943. S. KIESSKALT ET AL 2,323,544

OSCILLATION TUBE MILL

Filed Nov. 8, 1940

Fig. 1

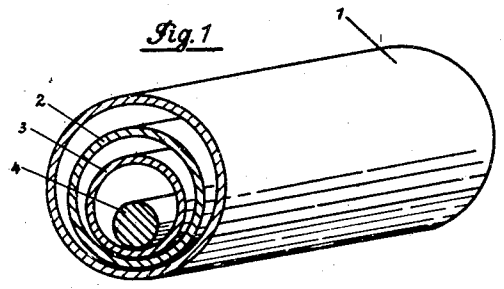


Fig. 2

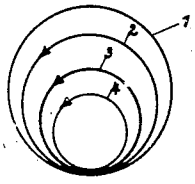


Fig. 2a

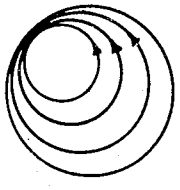


Fig. 2b

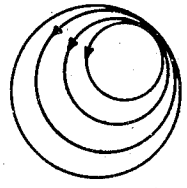


Fig. 3

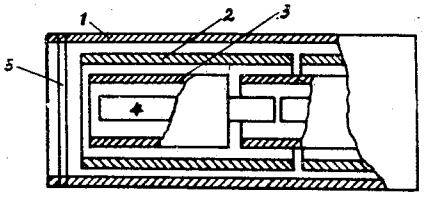
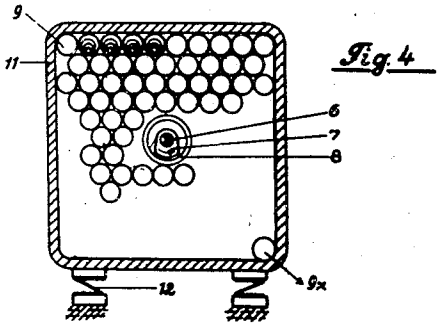


Fig. 4



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OSCILLATION TUBE MILL

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Application November 8, 1940, Serial No. 364,826
In Germany December 6, 1938

2 Claims. (Cl. 83—9)

The present invention relates to an especially effective oscillation tube mill comprising an outer tube-casing which may oscillate in a circular or approximately circular curve in a plane which is at right angles to its axis and a plurality of tubes or short sections thereof inserted one into the other and placed loosely into the outer tube, in longitudinal direction thereto, preferably having a solid cylindrical body in the centre, in such a manner that, when the outer tube-casing is caused to oscillate, these inserted bodies rotate against each other and against said outer tube-casing.

The oscillation-movement may be best accomplished if the difference between the inside diameter of a larger tube and the outside diameter of a smaller tube emboxed therein amounts to at most about the order of magnitude of the diameter of the circular curve. The frequency with such mills amounts to up to 60 cycles per second. It is also possible to combine parallely or approximately parallely a plurality of tube-casings having each inserted a series of milling tubes and to cause the whole system to oscillate.

Rotating tube mills comprising as milling bodies several tubes emboxed in each other and in the centre a solid cylindrical body are already known. These tube mills are, however, not actuated by an oscillation exciter, but the tube-shaped casing rotates with the effect that the contents of this casing exerts only a milling pressure which corresponds to the total weight of the tubes and/or rods. With the oscillation mills according to the present invention however, the active zone and, consequently, the effect are multiplied by the extremely rapid mechanical oscillations.

The accompanying drawing diagrammatically illustrates the invention. Fig. 1 shows a tube 1 of any length, for instance, of about 1–4 m. and of an inside diameter of 50 mm. into which a second tube 2, for instance, with an outside diameter of 46 mm. and an inside diameter of 40 mm. is loosely placed. Into this tube a third tube 3 having an outside diameter of 36 mm. and an inside diameter of 30 mm. is inserted and, finally, a round rod 4 of a diameter of 16 mm. is introduced thereinto. The outer tube 1 may be caused by any known method to perform circular or approximately circular oscillations whose paths lie at right angles to the axis of the outer tube 1.

If this system is excited to circular oscillations describing a curve of a diameter of about 3–6 mm. at a frequency of 12–25 cycles per second, the whole interior system of tubes emboxed in each other begins to rotate extremely rapidly. The movements are diagrammatically illustrated in Figs. 2, 2a and 2b.

Stroboscopic observation shows that all tubes roll off one in the other and that strong contact pressures are obtained in that proportion in which the acceleration of the rotary field is a multiple of the acceleration due to gravity. Since all tubes in each phase have the same radial direction, that is to say, have always the same contact points as shown in Figs. 2, 2a and 2b, the tubes roll-off while simultaneously performing a gliding movement which may be chosen at will. It is surprising that this latter movement takes place entirely regularly.

The surface action of the mill is extremely favorable. In some cases it is advantageous, when wet goods are to be milled, to fill the casing only partly.

As shown in Fig. 3 the outer tube 1 is undivided in length whereas the inner tubes 2 and 3 and the rod 4 are advantageously divided into short sections which need not all have the same length. In this way a very intimate contact of the inner milling bodies along their whole length is obtained even if the goods to be milled are irregularly distributed and of varying size.

A further advantage of this system resides in the fact that during the comminuting process the larger pieces of the goods to be milled travel for the most part towards the outer tube-casing whereas the smaller pieces are placed more towards the inside so that the larger pieces are the most exposed to mechanical treatment by the rotation of the emboxed inner tubes. The whole system of tubes is held together by a stop such as for example, a bolt 5 passed through the outer tube 1.

Fig. 4 shows a combination of a large series of tube systems 9 of the kind shown in Fig. 1, the whole arrangement being mounted in a frame 11 placed on elastic supports 12 and provided, for instance, with a so-called free-swinger drive which consists advantageously of a mass 7 rotating eccentrically round an axle 6. The latter is rigidly mounted at the common front walls of the parallel tube systems and the mass 7 rotates in a hollow cylinder 8. The combined tube systems 9 to 9x are thus commonly excited in the same phase.

For instance, goods which are to be milled in the wet state may be pumped in at tube 9 and passed through all of the tubes, one after the other, or only through a part thereof in case par-

allel currents are used. The goods would thus leave the mill at tube 9x in a finely milled state.

The circular oscillations may be produced in any known manner such as, for example, by so-called free-swinging drives as shown in Fig. 4.

Various materials may be used for the construction of the device. For instance, it is recommended in the case of a material which is liable to a great wear and tear to harden the surfaces of the tubes and rods, for instance, autogenously. With mills of this kind liquids or gases may be led in or out wherever wanted on the way of the material through the tubes.

We claim:

1. In an oscillating tube mill comprising in combination an oscillation exciter and grinding elements oscillated thereby the improvement which comprises a grinding element composed of an elongated outer tube oscillated by said oscillation exciter, means for introducing material to be ground into the interior of said tube, means for withdrawing material from said tube, a plurality of nested tubular grinding members loosely emboxed in said outer tube and extending longitudinally therein and means for retaining said members within said outer tube, said nested tubes being divided into separate sections of varying length and so arranged that a joint between the ends of sections of any given tube is not in register with the ends of the sections of a tube adjacent thereto.

2. An improved grinding element comprising in combination an elongated outer tube, a plurality of nested tubes loosely emboxed in said outer tube and extending longitudinally therein, said nested tubes being formed of a plurality of separate sections of varying length and so arranged that a joint between the ends of sections of any particular tube is not in register with the ends of sections of a tube adjacent thereto, and means for retaining said nested tubes in said outer tube.

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