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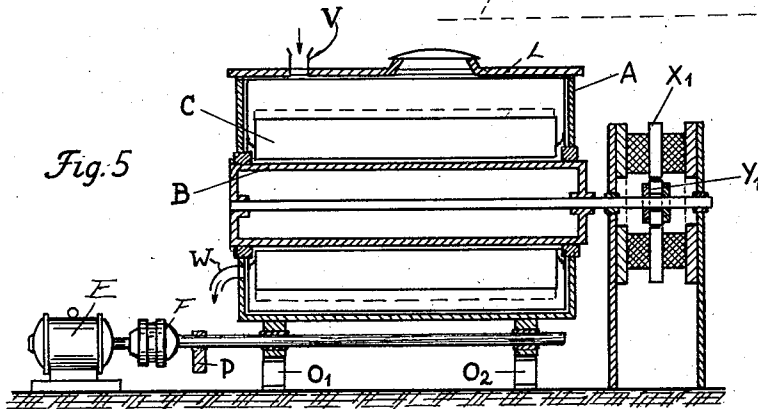
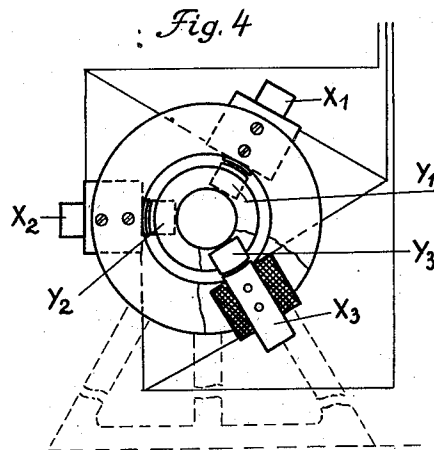
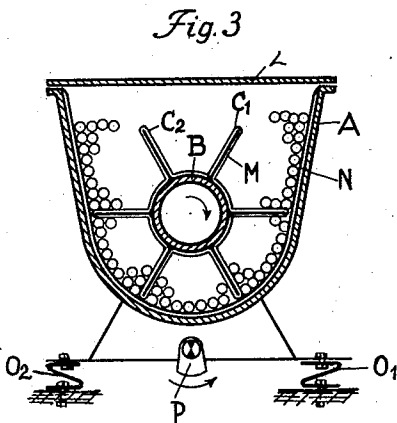
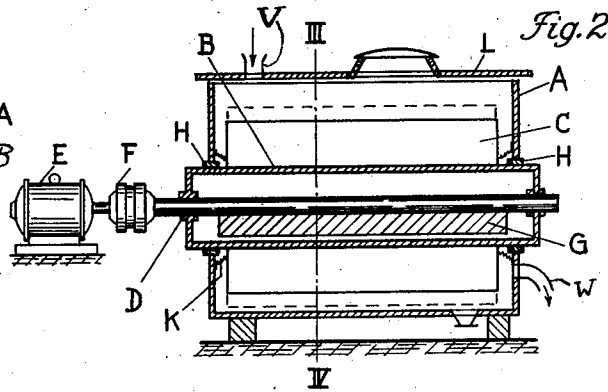
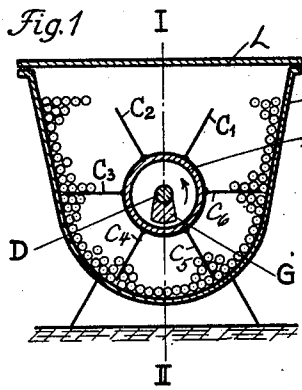
S. KIESSKALT

2,292,275

CRUSHING MILL

Filed March 11, 1939

2 Sheets-Sheet 1



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Fig. 6

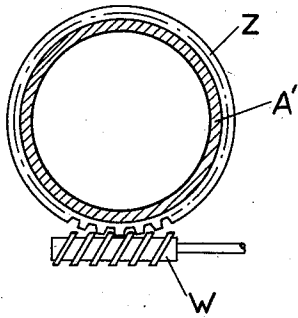


Fig. 7

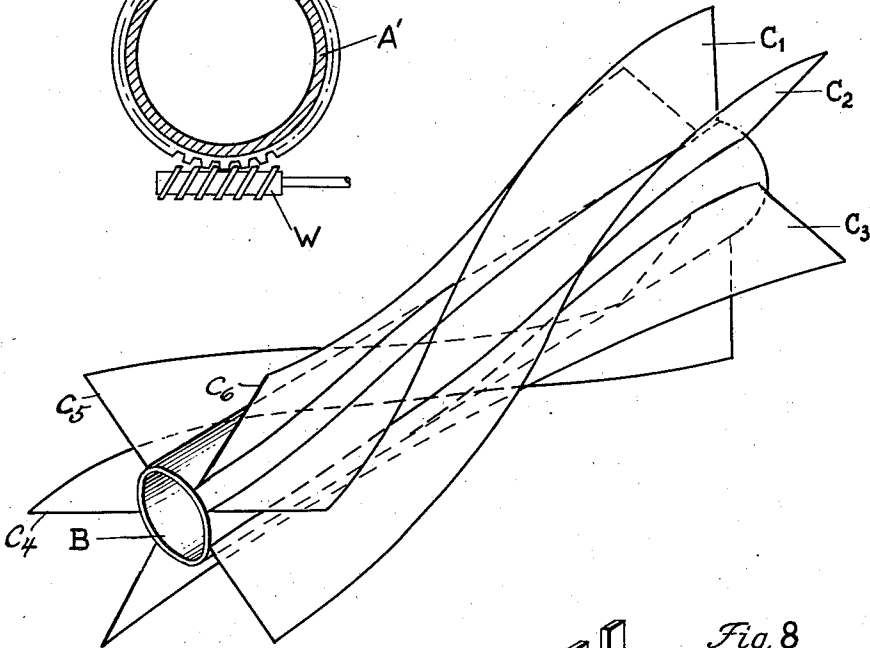
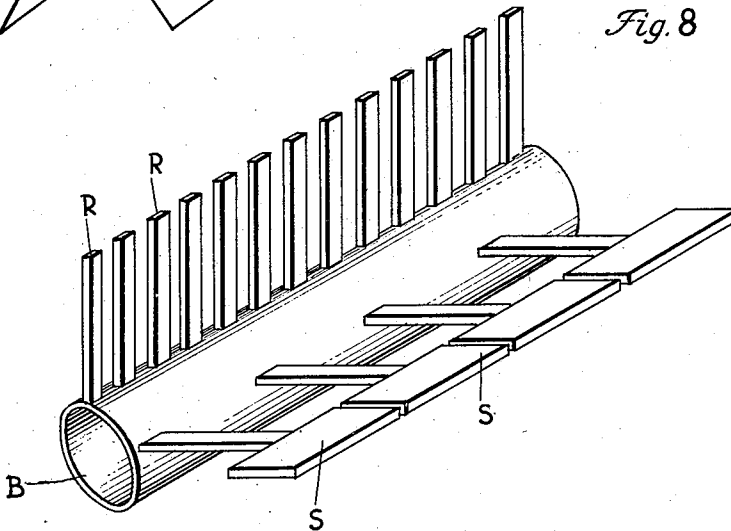


Fig. 8



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UNITED STATES PATENT OFFICE

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CRUSHING MILL

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8 Claims. (Cl. 83—9)

The present invention relates to a crushing mill.

Crushing mills are known which comprise a receptacle adapted to oscillate and containing various crushing elements such as balls, short cylinders or the like; in use, there are imparted to the receptacle, together with the crushing elements and the material to be crushed or pulverised, rapid mechanical oscillations of several hundred to several thousand cycles per minute.

This invention relates to an oscillating mill in which oscillating bodies preferably provided with members hereinafter called "oscillation transmitting members" are arranged between the crushing elements and the material to be crushed, the rapid mechanical oscillations of which bodies are relative to the receptacle. The said bodies oscillate either alone while the receptacle is stationary, or in a manner different from that of the oscillations of the receptacle. This arrangement facilitates the oscillatory motion and considerably larger surfaces may be used for transmitting the oscillations than in the case of a mill wherein the receptacle oscillates together with its whole contents. It is rather difficult structurally to fix in oscillating vessels oscillation transmitting members which oscillate together with the vessel. Hence the invention has the advantage that the oscillations are always relative to the receptacle and that the surfaces transmitting the oscillations can more readily be caused to oscillate than the receptacle itself.

In the case of a stationary receptacle in the mill there is the advantage that any connection, for instance, of pipes, can be of a simpler kind than that needed when the receptacle oscillates, since as these connections may also be stationary and need not oscillate or be prevented from oscillation by flexible couplings in case they touch oscillating parts.

The accompanying drawings illustrate the invention.

It is to be understood that the drawings illustrate applicant's apparatus by way of example and that the invention is not to be interpreted as being limited strictly to the modifications shown.

Fig. 1 is a vertical cross-section of one modification of the apparatus on line III to IV of Fig. 2.

Fig. 2 is a cross-sectional view of the same apparatus through line I to II of Fig. 1.

Fig. 3 is a further cross-sectional view show-

ing an apparatus in which provision is made to oscillate the entire apparatus.

Fig. 4 illustrates an electric drive for the oscillating body.

Fig. 5 is a longitudinal cross-sectional view showing the manner in which the electric drive illustrated in Fig. 4 can be applied to the apparatus depicted in Fig. 3.

Fig. 6 shows diagrammatically an arrangement wherein the receptacle is mounted so as to be capable of rotation.

Fig. 7 is a perspective view of one modification of the oscillating body and the members provided thereon wherein the latter are helical in shape, and

Fig. 8 is a perspective view of a variation of the modification illustrated in Fig. 7.

Trough or receptacle A of the mill is filled with crushing elements T and closed by lid L. Mounted therein is a tube-like body B. Plates C₁, C₂, C₃, C₄, C₅ and C₆ are mounted radially on this tube-like body B, which, in turn, is mounted upon shaft D driven by electro motor E by way of flexible coupling F. Shaft D has attached thereto an unbalanced weight G. Rapid rotation of shaft D imparts circular oscillations to body B and the radially arranged plates C₁—C₆ thereon. In order to accomplish this result, body B is mounted inside the receptacle A by elastic rings H of rubber or the like so that body B may oscillate without any disturbance. If it is so desired, the receptacle may be tightened at these parts by membranes K against the oscillating radiated element. The materials to be crushed may, for example, be introduced through opening V in lid L and withdrawn through exit opening W from another part of the apparatus. When the machine is in operation the entire space within the trough inclusive of the spaces between the arms of the star is filled nearly to the rim of the trough with crushing elements T, for instance balls (in order to avoid confusion in the drawings only some of these balls are shown), between which the material to be crushed is situated.

On rotation of the unbalanced mass G, tube B with the arms C₁, C₂, C₃, C₄, C₅ and C₆ performs circular oscillations. Should some spaces, for instance those below the members C₃, C₄, C₅ and C₆ remain only partly filled during the charging of the crushing elements and the material to be crushed, they are automatically filled when the oscillation exciter is set in operation. By the action of the oscillating members C₁, C₂, C₃, C₄, C₅ and C₆, the crushing elements move

rapidly and violently; they rotate and oscillate simultaneously and thereby the material is comminuted very quickly and thoroughly. With reference to Fig. 3, the interior portion of receptacle A and the surfaces of body B and members C₁, C₂, C₃, C₄, C₅ and C₆ are provided with soft rubber material M and N. Furthermore, an arrangement is shown whereby not only body B and elements C oscillate but also trough or receptacle A is elliptically mounted on springs O₁ and O₂ and caused to oscillate by the rotation of unbalanced weight P. When receptacle A and body B are both caused to oscillate, it is important that the curved path, frequency, amplitude or phase of the oscillations of the receptacle or several of these components differ from those of the oscillations of the blade system. Relative oscillations occur for instance when the receptacle arranged in an oscillating manner is elastically coupled with the system of oscillating blades, various known mechanical constructions for this coupling system being possible.

An electro-magnetic drive for body B is illustrated by way of example in Fig. 4. In this modification the unbalanced weight method of imparting oscillation to body B is substituted by an electro-magnetic system. X₁, X₂ and X₃ represent three electro-magnets connected to a 3-phase electric current in the manner shown, from which it will become apparent that they are excited in rotation, i. e., first X₁ is excited, then X₂, then X₃, then X₁ again and so on. Opposite each of these electro-magnets and affixed to an oscillatable part of the apparatus, for example body B with its blades C₁, C₂, C₃ etc., is a pole-piece, Y₁ being opposite X₁, Y₂ opposite X₂ and Y₃ opposite X₃. Due to the alternate attraction and repulsion between each pole-piece and the magnet opposite thereto, the part of the apparatus to which the pole-pieces are attached is caused to oscillate with a more or less circular motion.

The manner in which such an electro-magnetic system for imparting oscillation with the apparatus is illustrated in Fig. 5. Means for imparting oscillation to receptacle A, as shown in Fig. 3, is also illustrated in Fig. 5. Examination will show that electro-motor E, acting through flexible coupling F, causes rotation of unbalanced weights P and P' in order to oscillate receptacle A on spring supports O₁ and O₂.

It is also within the scope of my invention to employ a cylindrical vessel such as that designated by reference character A' in Fig. 6. This receptacle is caused to rotate slowly, due to the action of worm and worm-wheel X and Z respectively, and has mounted within it an oscillatable body not shown in this figure but similar in construction to those designated by reference character B in Figs. 1, 2, 3, 5, 7 and 8. If body B in the interior is caused to oscillate, its oscillating energy should be great enough to add to the relative movement of the crushing elements already imparted to said elements by the slow rotation of cylindrical vessel A'.

As crushing elements there may be used spheres or short cylinders of hard porcelain or steel, coarse grained quartz sand, flint or the like. According to the special purposes of the grinding and the necessity for accommodating the mill between other devices the receptacle may be in horizontal or vertical position and the oscillating systems correspondingly vertical or horizontal. In addition to oscillating the bodies trans-

mitting oscillations or groups of these bodies as well as the receptacle may rotate.

Instead of being straight oscillation imparting members, C₁, C₂, C₃, C₄, C₅ and C₆ may also be helically wound about body B in the manner shown in Fig. 7. Due to the angle between the direction of oscillation and a perpendicular through the plane of any of these helically wound elements, it is evident that a further rotation of the grinding balls is produced and that more efficient grinding action is consequently obtained.

The shape of the elements transmitting the oscillation of body B to grinding elements T may be modified in many ways. Thus, for example, in Fig. 8, one such member is replaced by a number of radially mounted rods R while another is substituted by paddle-like plates S. It is preferable to subdivide these members when it is intended to grind heavy and viscous materials which tend to agglomerate to form compact masses.

It has already been proposed to grind a material with the aid of crushing elements in a vessel without the application of oscillations, the crushing elements being moved by means of a stirrer. This method has nothing in common with the present invention which involves oscillations. The said method is not practicable, since blocking and jamming occur during the stirring and much driving-power is necessary, against which there is hardly an improvement in the grinding effect to be set and the crushing elements and device are quickly worn and often destroyed.

When a charge of crushing elements is caused to perform oscillations the permanent high degree of mobility of the charge enables the oscillating system to add a slight stirring motion. This stirring chiefly promotes the mixing of the contents of the mill whereas the grinding effect is chiefly due to the oscillation.

I claim:

1. A device for crushing dry or moist material which comprises a receptacle, a body mounted therein for oscillation relative to said receptacle, radially extending oscillation transmitting members on said body, crushing elements within said receptacle and in contact with said body, said receptacle and said oscillation transmitting members and means for imparting rapid oscillation to said body.

2. A device for crushing dry or moist material which comprises a receptacle, a body mounted therein for oscillation relative to said receptacle, radially extending blades on said body, crushing elements within said receptacle and in contact with said body and said blades and means for imparting rapid oscillation to said body.

3. A device for crushing dry or moist material which comprises a receptacle, a body mounted therein for oscillation relative to said receptacle, radially extending helical blades on said body, crushing elements within said receptacle and in contact with said body and said blades and means for imparting rapid oscillation to said body.

4. A device for crushing dry or moist material which comprises a rotatable receptacle, a body mounted therein for oscillation relative to said receptacle, radially extending oscillation transmitting members on said body, crushing elements within said receptacle and in contact with said body and said oscillation transmitting

members and means for imparting rapid oscillation to said body.

5. A device for crushing dry or moist material which comprises a receptacle, crushing elements within said receptacle, a body mounted in said receptacle having members extending radially therefrom and adapted to promote relative movement between said crushing elements and said receptacle and means for imparting relative rapid oscillatory movement between said body and said receptacle.

6. A device for crushing dry or moist material which comprises a fixed receptacle, crushing elements within said receptacle, a body oscillatably mounted in said receptacle having members extending radially therefrom and adapted to contact and promote relative movement between said crushing elements and said receptacle and means for imparting rapid oscillatory movement to said body.

7. A device for crushing dry or moist mate-

rial which comprises a resiliently and oscillatably mounted receptacle, crushing elements within said receptacle, a body mounted in said receptacle for oscillation relative thereto, said body having members extending radially therefrom and adapted to contact and promote relative movement between said crushing elements and said receptacle and means for imparting a rapid oscillatory movement to said receptacle and a different oscillatory movement to said body.

8. A device for crushing dry or moist material which comprises a rotatable receptacle, crushing elements within said receptacle, a body mounted in said receptacle having members extending radially therefrom and adapted to promote relative movement between said crushing elements and said receptacle and means for imparting relative rapid oscillatory movement between said body and said receptacle.

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