

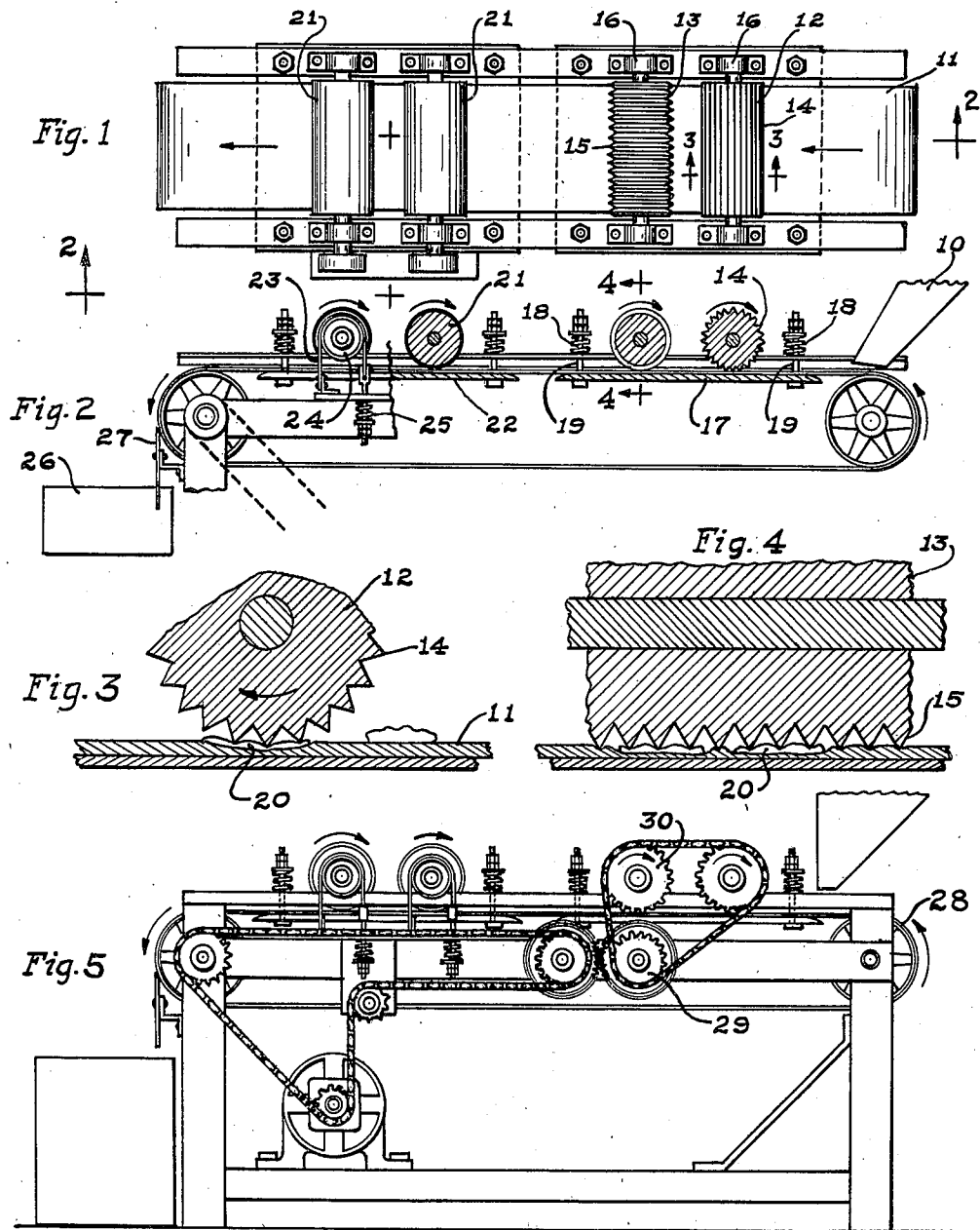
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TREATMENT OF LAMELLAR MATERIALS

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TREATMENT OF LAMELLAR MATERIALS

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This invention relates to treatment of lamellar or foliated minerals and the like and, among other objects, aims to provide means for mechanically subdividing minerals of this character into thin flakes.

The nature of the invention may be readily understood by reference to an embodiment thereof illustrated in the accompanying drawing and described in the following specification.

In said drawing:

Fig. 1 is a plan view of an apparatus for effecting the aforesaid subdivision;

Fig. 2 is a sectional elevation thereof taken on the plane 2—2 of Fig. 1;

Fig. 3 is an enlarged sectional view of a detail taken on the plane 3—3 of Fig. 1;

Fig. 4 is a transverse section of a detail taken on the plane 4—4 of Fig. 2; and

Fig. 5 is a side elevation of a modified form of apparatus.

Minerals of the character above referred to are characterized by a multitude of very thin laminae cohering with varying degrees of tenacity depending upon the type of mineral. In some types, such as vermiculite, phlogopite, jefferite, etc., the bond between the laminae is less firm than in other types and the granules may be more easily split into very thin flakes.

In the present instance, minerals such as vermiculite are split or subdivided by bending pieces of the mineral sufficiently to fracture or very nearly fracture the bond between the laminae. Preferably the mineral is reduced by crushing to provide flat pieces of such thinness ($\frac{1}{16}$ to $\frac{1}{8}$ of an inch) that they may be bent slightly without being crushed. Bending of such pieces causes a slight slippage between adjacent laminae or thin groups of laminae, thus rupturing or so greatly weakening the bond between them that the material will readily split into thin flakes.

The drawing illustrates one type of apparatus for applying to the pieces of the material the bending and other forces necessary to subdivide the material into thin flakes. As here shown, the raw material, which has previously been prepared in relatively thin flat pieces of about $\frac{1}{16}$ " to $\frac{1}{8}$ " in thickness, is delivered from a hopper or chute 10 to a travelling conveyer in the form of a belt 11. The rate of feed is preferably such as to supply only a single layer of pieces on the belt. Thus distributed on the belt, the material is in this instance subjected to bending forces which successively bend the pieces first in one direction and then in a direc-

tion approximately at right angles to the first bending. The bending means are here shown in the form of a pair of rolls 12 and 13 carrying teeth 14 and 15 (see Figs. 3 and 4). The teeth 14 extend longitudinally of the roll 12 and the teeth 15 extend circumferentially around roll 13. The rolls are mounted in bearings 16 in such position that the teeth firmly engage the pieces of material on the belt as they pass under the rolls. In this region the belt is preferably supported by a platen 17 mounted to resist the pressure of the teeth on the material. In the present instance the mounting of the platen is resilient to allow it to compensate for variations in thickness of the pieces of material. The resilient mounting is here shown in the form of a plurality of springs 18 which upwardly urge the platen supporting bolts 19. In the present instance, four such springs are employed adjacent the corners of the platen; these urge the platen upwardly with an aggregate force of approximately two hundred pounds. The pressure against the roll obviously varies for roll lengths and roll diameters. The belt 11 may advantageously be relatively soft (such as a rubber belt) to yield under the action of the roll teeth, thereby facilitating the bending of the pieces of material.

Figs. 3 and 4 diagrammatically illustrate, in an exaggerated manner, the action of the rolls on the pieces of material. Fig. 3 shows a piece of material 20 passing under roll 12 and being bent transversely by teeth 14. Fig. 4 shows a piece of material 20 bent by the action of the circumferential teeth 15 of roll 13. Thus each piece of material is flexed first in one direction and then in a different direction at a substantial angle to the first flexing, thereby rupturing or substantially rupturing the bonds between laminae and thin groups of laminae. The laminae are almost microscopic in thinness and of such flexibility that probably the pieces of material are split into very thin flakes comprising two or more laminae rather than into individual laminae.

To complete separation between the flakes along their cleavage planes, the material, after being subjected to the aforesaid bending action, is subjected to forces parallel to the cleavage planes. In the present instance, such forces are applied by one or more rolls 21 engaging belt 11 but having a differential movement relative thereto. The rolls are preferably faced with rubber or some friction material for engaging the material. The aforesaid differential movement

serves to exert friction forces on the pieces of material on planes parallel to their cleavage planes, thus causing the flakes to slip one on the other and thus completely fracturing their cohesion to adjacent flakes.

The differential travel between the belt and rolls 21 may be effected by driving the rolls either faster or slower than the belt. In the present instance, the belt is pressed against the rolls by platen 22 resiliently supported in a manner similar to platen 17 and serves to drive the rolls by frictional contact. A friction drag or brake is applied to the rolls to cause them to resist rotation and thus slip slightly with reference to the belt and with reference to the pieces of material passing under the rolls. The drag in this instance is provided by brake band 23 drawn into frictional contact with the roll brake drum 24 by an adjustably tensioned spring 25. The material thus subdivided into thin flakes is discharged from the belt into a receiver 26. A scraper blade 27 removes material adhering to the belt.

In Fig. 5 is illustrated a form of apparatus for use with a relatively hard belt, such as a leather belt 28. The apparatus is in other respects similar to that illustrated in Figs. 1 and 2 except that the bending rolls are positively driven at a speed which is either slightly higher or slightly lower than the speed of the belt in order to exert a combined bending and skiving action on the pieces of material. The latter action simultaneously applies force to the pieces of material in a direction parallel to the planes of cleavage. Owing to the lower resilience of the leather belt, the pieces of material are not bent so greatly as when a softer belt is used and the supplementary forces exerted by the teeth of the bending rolls in a direction parallel to the planes of cleavage serve to complete the rupture of the bond between laminae or thin groups of laminae. The material thus treated is subsequently passed under friction rolls similar to rolls 21 to cause the thin flakes to slip on each other and thus complete the subdivision.

In the present instance, the bending rolls are positively driven by chain and sprocket from the belt drive (see Fig. 5). The relative speed between the belt and the rolls is effected by using a driving and driven sprocket 29 and 30 of different size.

Preferably it is desirable to provide thin flakes of material which are substantially smaller in area than the pieces of material fed into the machine. The teeth of the bending rolls may advantageously be made sufficiently sharp to cut into the material and thus somewhat subdivide the material. Where it is desirable thus to cut the material so as to produce smaller flakes during the aforesaid process of splitting, the pressure of the platen 17 is adjusted to permit the teeth to exert sufficient force for this purpose.

Whether or not the bending rolls are positively driven with a differential speed as illustrated in Fig. 5 depends largely upon the softness of the belt. Belts softer than ordinary leather belts generally need not be thus driven to produce the desired result.

Obviously the invention is not limited to the details of the illustrative embodiment thereof herein described. Moreover it is not indispensable that all features of the invention be used conjointly since various features may be used to advantage in different combinations and sub-combinations.

Having described our invention, we claim:

1. Apparatus for subdividing foliated mineral material comprising in combination a conveyer belt for carrying a layer of flat pieces of said material with their laminae generally parallel to the face of the belt, a plurality of rolls having teeth for flexing said pieces on the belt in directions transverse to the laminae, the teeth on the respective rolls being arranged to flex the pieces in about different axes to weaken the bond between the laminae, and means subsequently engaging said pieces to split the same at the weakened bonds into a plurality of very thin flakes.

2. Apparatus for subdividing foliated mineral material comprising in combination a conveyer belt for carrying a layer of flat pieces of said material with their laminae generally parallel to the face of the belt, a pair of rolls respectively having longitudinal and circumferential teeth thereon to flex said pieces on the belt in different directions to weaken the bonds between laminae, and means subsequently engaging said pieces to split the same at the weakened bonds into a plurality of very thin flakes.

3. Apparatus for subdividing foliated mineral material comprising in combination a conveyer belt for carrying a layer of flat pieces of said material with their laminae generally parallel to the face of the belt, a pair of rolls respectively having longitudinal and circumferential teeth thereon to flex said pieces on the belt in different directions to weaken the bonds between laminae, means for causing said rolls to rotate at peripheral speeds different from the speed of said belt, and means subsequently engaging said pieces to split the same at the weakened bonds into a plurality of very thin flakes.

4. Apparatus for subdividing foliated mineral material comprising in combination a conveyer having a resilient relatively flat face for carrying a layer of flat pieces of said mineral, a flexing device for pressing upon a portion only of the area of said pieces while the same are supported on the flat surface of said conveyer to flex the same relatively sharply in a direction transverse to their laminae to weaken the bond between the laminae, and means for subsequently engaging said pieces for separating the laminae at the weakened bonds into a plurality of very thin flakes.

5. Apparatus for subdividing foliated mineral material comprising in combination a conveyer having a resilient surface for carrying a layer of flat pieces of said mineral, a flexing device having narrow engaging faces for pressing upon a portion only of the area of said pieces as they are advanced by said conveyer and pressing said pieces to flex the same relatively sharply, and a friction roll rotating at a speed different from the belt for subsequently engaging said pieces on said belt to exert friction forces thereon in a direction parallel to the laminae to separate the pieces into very thin flakes.

6. The method of subdividing lamellar materials into very thin flakes which is characterized by flexing flat pieces of the material whose laminae are substantially parallel to the flat faces of the material by applying bending forces thereto in a plurality of angularly separated positions so as to flex the laminae in a plurality of angularly separated directions each transverse to the cleavage planes of the material to weaken the bond between the laminae or thin groups of laminae, and then applying forces substantially parallel to the planes of cleavage to

split the material at the weakened bonds into very thin flakes.

7. The method of subdividing lamellar materials into very thin flakes which comprises bending flat pieces of the material whose laminae are substantially parallel to the flat faces of the material so as to flex the laminae in a direction transverse to the cleavage planes and simultaneously with said flexure applying forces to the pieces of material in a direction substantially parallel to the cleavage planes between the laminae to weaken the bonds between the laminae or thin groups of laminae, and then applying forces to said pieces of material to cause the laminae or thin groups of laminae to slip relatively to separate said pieces into very thin flakes.

8. Apparatus for subdividing folded material into very thin flakes comprising in combination a carrier for carrying a layer of flat pieces of material whose laminae are substantially parallel with the flat faces of the material, means for simultaneously flexing said pieces across their laminae as they are advanced by said conveyer and for exerting forces thereon in a direction substantially parallel to the laminae to weaken the bond between the laminae, and means subsequently engaging said pieces to split the same at the weakened bonds into a plurality of very thin flakes.

9. Apparatus for subdividing flat pieces of

lamellar mineral material whose laminae are substantially parallel to the flat faces of the material comprising in combination a conveyer for carrying the material with the flat faces thereof lying against the conveyer, a roll having teeth thereon for engaging the flat faces of the material on said conveyer to flex the pieces in a direction transverse to the laminae to weaken the bonds between the laminae or thin groups of laminae, and means for causing the roll to rotate at a peripheral speed different from the speed of said conveyer to exert a force on the pieces when flexed in a direction substantially parallel to their laminae.

10. Apparatus for subdividing foliated mineral material comprising flat pieces whose laminae are substantially parallel with the flat faces of the material comprising in combination a conveyer for carrying a layer of pieces with their flat faces against the conveyer, a pair of bending devices for engaging the flat faces of the material on the conveyer and bending the same successively in a plurality of angularly separated directions transversely to the cleavage planes of the material to weaken the bond between the laminae, and means for subsequently applying forces substantially parallel to the planes of cleavage to split the material at the weakened bonds into a plurality of very thin flakes.

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