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J. M. COFFEY ET AL

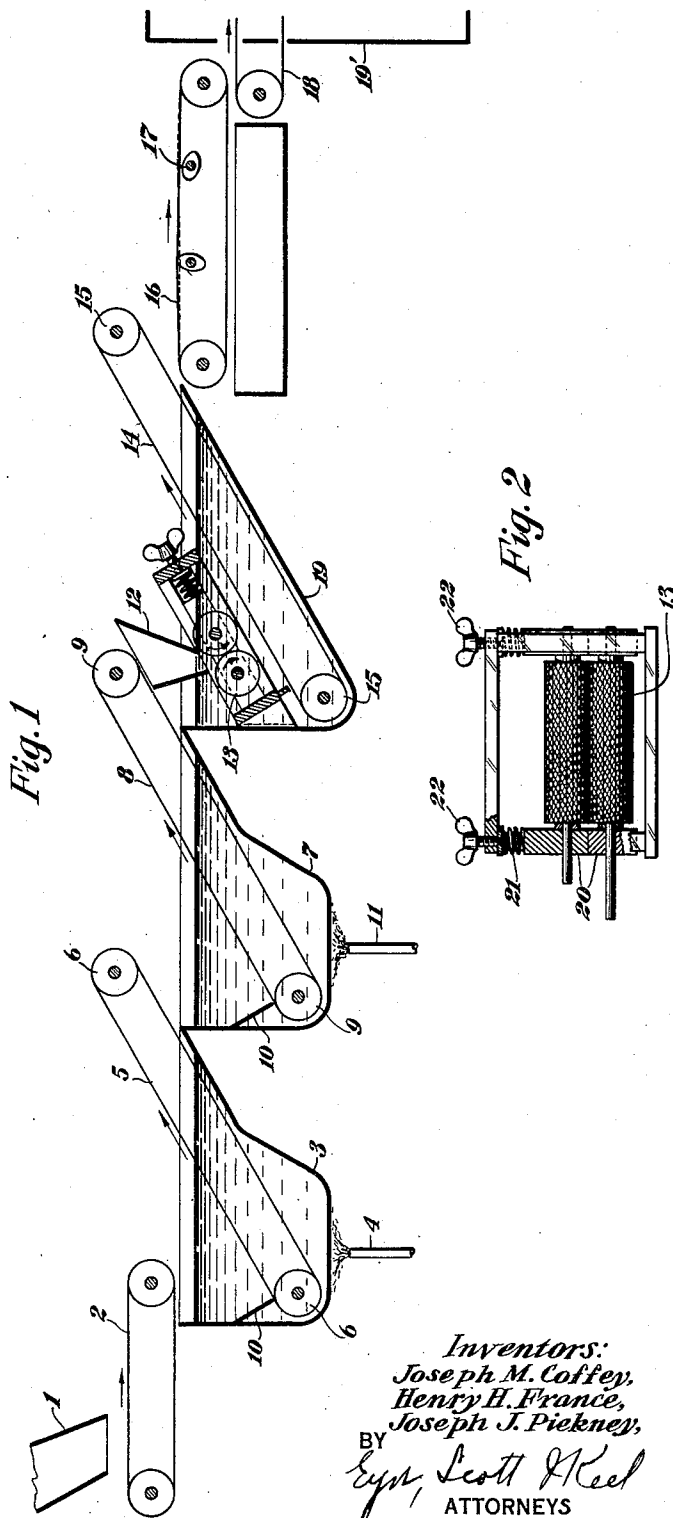
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PROCESS OF MICA SPLITTING AND MACHINE THEREFOR

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Fig. 3b

Fig. 3a



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PROCESS OF MICA SPLITTING AND MACHINE THEREFOR

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Our invention comprises a new process for the splitting of mined mica block and a novel machine for carrying out the process. Mined mica comes in irregular shaped blocks of various thicknesses and grades. These blocks have to be split for commercial use to obtain the thin layers of natural mica therein. Formerly mined mica was split by the use of a knife or by passage through corrugated rollers, with or without preliminary heat treatment. Splitting with a knife is slow, inaccurate and uneconomical in that only a high grade of mined mica can be satisfactorily split in this way, and, where crystals adhere to the edges of the block, the block must first be trimmed. Corrugated rollers tend to fracture the thin mica films, which is undesirable. Neither method is practicable for any but high grade mica, as neither will satisfactorily split mica in which faults or cross grains occur. Our method avoids the drawbacks of these methods and effects a great saving in that it will satisfactorily split low grade mica and in that the splitting can be effected rapidly and by means of simple apparatus.

Our preferred process for splitting mined mica blocks comprises first treating the blocks in a hot acid solution, then treating them in a hot neutralizing solution, and thereafter passing the blocks between rotating rollers, the circumferential speeds of which are different and which are immersed in water. The rollers act with a shearing force upon the mica block and separate the natural layers by slippage therebetween. The mica flakes are then dried and sifted and complete separation may be effected in any manner as by blowing or agitation. We prefer to effect the final separation by the machine invented by one of us, viz: J. M. Coffey, and described in his Patent No. 1,720,666, dated July 16, 1929, which likewise sorts the flakes in preparation for commercial use.

We have found that the initial treatment of the mica blocks both in the hot acid solution and in the hot neutralizing solution is of great value in loosening the mica layers. This part of our process could be used satisfactorily in conjunction with other known

methods such as the use of corrugated rollers or cleavage by knife mentioned above, as it materially increases the effectiveness of these known methods.

The particular acid solutions which we employ depend upon the kind of mica block to be treated. In general the hardest block is preferably treated in the strongest acid solution, less hard block in weaker solutions, and, in some cases of fairly soft or loose mica block, we have found that treatment in boiling water alone is sufficient, in which case, of course, the neutralizing step is dispensed with. For the hardest blocks we have found that a solution containing 85% water, 10% sulphuric acid and 5% hydrofluoric acid, gives good results. For less hard blocks, we have satisfactorily employed a 12% solution of sulphuric acid and water. For the neutralizing bath we employ a solution of sodium bicarbonate, of strength sufficient to neutralize all the acid adhering to the blocks. Other neutralizing solutions could, of course, be employed. In the neutralizing bath a strong effervescence of escaping carbon dioxide occurs in the form of a white foam. This strong effervescence contributes toward making the mica layers more readily separable. In choosing the particular acid solution for the initial treatment, it is of course desirable that the least strong solution be used that will produce the desired result, both from the point of view of economy of the acid, and in the case of hydrofluoric, to prevent any unnecessary attack by the acid on the mica itself. If the mica block is sufficiently soft, treatment in boiling water, rather than in acid, is, of course, preferred. It is preferable, but not essential that the treatment in the acid solution precede the treatment in the alkali. We have obtained satisfactory results, however, by reversing the procedure of this part of our process.

The mica block, after being treated in the acid and alkali solutions, or in water, is then made to pass between rollers having a preferred circumferential speed ratio in the neighborhood of 3 to 1 or 4 to 1. The most satisfactory speed ratio depends upon the average thickness of the block being treated,

the thicker the block, the higher the preferred speed ratio. Preferably the surfaces of the rollers are knurled and the rollers are yieldably forced together to insure proper gripping of blocks of different thicknesses.

For a better understanding of our invention, reference should be had to the accompanying drawing, of which:

Fig. 1 illustrates somewhat diagrammatically our machine for carrying out our process;

Fig. 2 is a view partly in section of the differential speed rollers with their supporting structure; and

Figs. 3a and 3b show a mica block before and after treatment respectively.

Referring to the drawing, mined mica blocks, in the form shown diagrammatically in Fig. 3a is fed from a hopper 1 upon traveling belt 2 from which it falls into the acid solution in trough 3. The acid solution is maintained at the boiling point by any suitable means, such as the gas burner 4. A traveling spiral conveyor 5 passing over rollers 6 carries the block from the acid solution and delivers it to a neutralizing solution in trough 7 where it falls upon a similar traveling belt 8 passing over rollers 9. Screens 10 in the troughs 3 and 7 prevent the block from sliding off the traveling belts. The neutralizing solution in trough 7 is likewise maintained at boiling temperature as by gas burner 11. Mica falling from the traveling conveyor 8 passes through a chute 12 and is delivered between rollers 13 where the laminations are forced apart by slippage therebetween. The mica, now either in the form shown diagrammatically in Fig. 3b, or in the form of thin flakes, is carried by a conveyor 14, passing over rollers 15, and deposited upon another traveling spiral belt 16 upon which it is agitated as by rollers 17 to remove the water therefrom. After leaving belt 16 the flakes drop upon a conveyor 18 which carries them into an oven for drying the flakes. As any suitable oven structure may be employed, the end wall only of the oven is shown at 19'. The rollers 13 are preferably immersed in water in a trough 19. As shown in Fig. 2, the rollers 13 are supported in bearings 20, which bearings are yieldably held together by spring 21, the force of which may be adjusted by wing nut headed screws 22. The surfaces of the rollers 13 are preferably knurled. They are driven through suitable gearing (not shown) at different circumferential speeds in order to effect the separation of the flakes.

The rollers 13 are preferably of case-hardened steel, and that part of the rest of the supporting structure which is immersed in water, as shown by Fig. 1, is preferably constructed of Monel metal, to avoid rusting thereof. The traveling belts 5, 8 and 14 are

of spiral wire and preferably of non-corroding rustless material, such as Monel metal.

Any suitable means may be provided for driving the various traveling belts. Preferably the belts 5 and 8 are driven at a slower rate than the belts 14 and 16, as a fairly long period of immersion in the acid and neutralizing solutions is desirable. We have found that immersion for twenty minutes or so in each of the acid and neutralizing solutions is in most cases sufficient for a satisfactory loosening of the layers.

The agitation of the flakes caused by the rollers 17 not only effects partial drying of the same, but likewise aids in their complete separation.

Instead of gas burners 4 and 11 illustrated, the solutions may be conveniently heated by the passage of steam into the troughs 3 and 7.

We have found that mined mica block treated by such a machine as that of Fig. 1 when using suitable strength of acid solution and neutralizing bath, as described above, receives almost complete separation of the layers. In rare cases, however, certain of the hardest blocks may pass through the machine without appreciable separation. Obviously, a conveyor could be arranged to return unsplit blocks for further treatment, either delivering them to the acid solution to go through the complete process, or to the chute 12 to be merely passed through the differential speed rollers 13 a second time. If desired, of course, a second set of rollers 13 could be arranged in series with those shown in the drawing to insure the complete separation of the block in one passage through the machine. We prefer, however, to utilize only one set of such rollers, as such a large percentage of the blocks are split in this way that it is not advantageous to send all of the mica block through two sets of rollers, but only such as is not completely split by one set of rollers.

In the patent referred to above of J. M. Coffey for a sorting machine, a return conveyor for such insufficiently split mica is disclosed. When the sorting machine of that patent is used with the process herein described such return conveyor could be used to return such unsplit blocks to either the chute 12 or to the acid solution.

It is not essential that the differential speed rollers be immersed in water, as we have succeeded in effecting very satisfactory separation of the layers without such immersion. We have found, however, that more efficient results are obtained by maintaining the mica block in a saturated condition during the entire treatment, and, therefore, prefer to immerse the rollers.

We have now described our novel process for splitting mined mica block, and one embodiment of our machine for carrying out the process. We believe it to be broadly

novel with us to loosen the laminations of mica block of immersion in boiling liquid, whether the liquid be water or solutions such as are described herein. Likewise, we believe it to be broadly novel with us to effect the actual separation of the layers by passing through differential speed rollers, whether or not the rollers are immersed in water.

We claim:

10 1. The process for splitting mica block comprising first immersing the block in boiling liquid to loosen the layers and then mechanically acting upon the same to effect their separation.

15 2. The process for splitting mica block comprising immersing the block in hot acid and neutralizing solutions, then acting upon the block mechanically to effect the separation of the layers.

20 3. The process for splitting mica block comprising first immersing the block in boiling liquid to loosen the layers, and then passing the block between rotating rollers immersed in water and having different circumferential speeds.

25 4. The process for splitting mica block comprising first loosening the layers by treating the block in a boiling solution containing sulphuric acid, then treating the block in a boiling neutralizing solution, and thereafter acting mechanically upon the block to effect the separation of the layers.

30 5. The process for splitting mica block comprising first loosening the layers by treating the block in a boiling solution containing sulphuric and hydrofluoric acids, then treating the block in a boiling neutralizing solution, and thereafter acting mechanically upon the block to effect the separation of the layers.

40 6. The process for splitting mica block comprising first loosening the layer by treatment in boiling acid and neutralizing solutions and then passing the block between rollers having different circumferential speed ratios.

45 7. The process according to claim 6 wherein the block is maintained under water during passage between the rollers.

50 8. The process for splitting mica block comprising first treating the block in boiling liquid to loosen the layers, then passing the block between rotating rollers immersed in water and having different circumferential speeds to separate the layers, then agitating the layers thus separated to remove adhering water and finally passing the layers through a heated zone to dry the same.

55 9. A machine for splitting mica block comprising in combination two troughs adapted to contain liquid and provided with heating means to boil the liquid therein, a third trough adapted to contain liquid, a pair of rollers adapted to be rotated at different circumferential speeds and located within the

liquid in said third trough, conveying means for depositing mica block in and removing it from said first two troughs in succession, means for receiving the block from said conveying means and for feeding the same to said rollers, and means for removing the mica from said third trough after passage through said rollers.

10. The process for splitting mica which comprises first maintaining the block immersed in boiling liquid for a substantial period of time to loosen the layers and then mechanically acting upon the block while still wet to effect the separation of the layers.

In witness whereof, we have signed our names to this specification.

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