Nov. 24, 1936. F. A. SLATER 2,061,812

METHOD OF SORTING MATERIALS

Filed Feb. 16, 1933

Fig. 2.

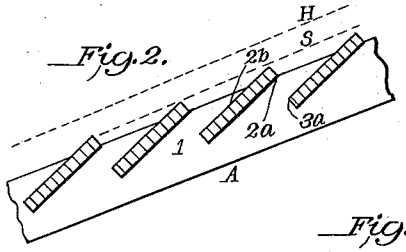


Fig. 1.

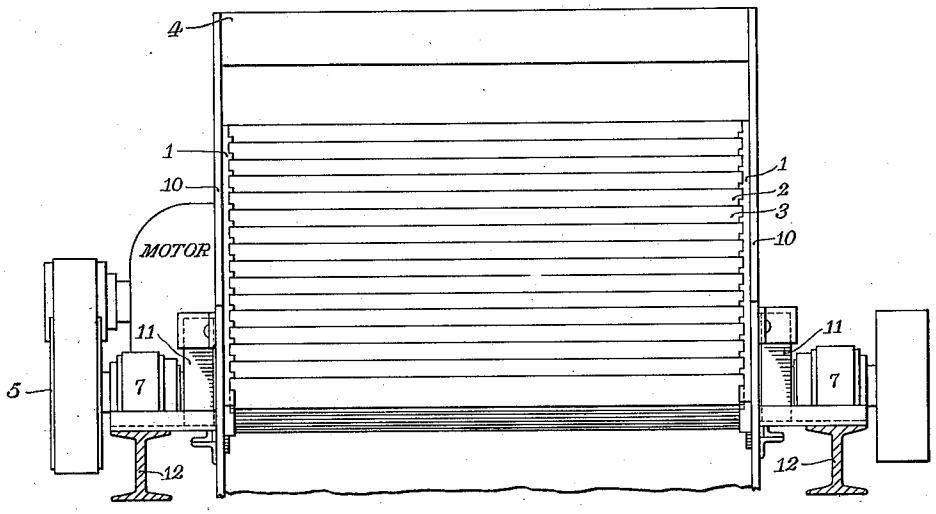


Fig. 3.

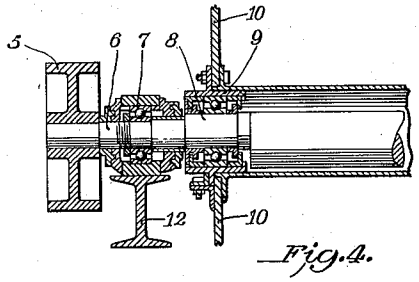


Fig. 4.

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METHOD OF SORTING MATERIALS

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2 Claims. (Cl. 209—2)

This invention relates to methods for separating shale from natural gravel found in glacial gravel deposits. It is desirable and required in engineers' and architects' specifications that road material or cement aggregate contain only a limited amount of soft frangible substances.

In working such deposits for material to be used in the making of concrete it has been customary heretofore merely to screen the material taken from the pit and thereby to discard the stones and shale pieces that are over the desired maximum size and under the desired minimum size; that is to say, the material is screened between arbitrary limits in the usual way.

All of the material, having been sized between the desired maximum and minimum limits by screens, must next be freed from shale pieces, and it is an object of this invention to provide an improved means and a process for effectively attaining that separation to a degree of completeness which satisfies the commercial requirements. For example, pit gravel consists of water-worn pebbles of very hard rock, granite, spar, trap rock etc. intermingled with from one to fifteen per cent of softer stone consisting of shale, which although hard in the natural state, disintegrates when exposed to air, and pieces of limestone and sandstone which are fairly hard but light. These pieces of shale and lighter material are known as floaters because they float to the top in a concrete mixer.

It is these floaters or softer pebbles and shale which are removed by the present invention. The hard rock pieces are mostly of round or egg shape and the shale and floater pieces are softer and of somewhat flattened egg shape. After screening this material between the desired limits all of the pebbles, including both the hard pieces and the floaters, are of approximately the same size.

The novel principle according to which the present invention operates to separate the shale pebbles from the hard pebbles has several advantages. It requires only a small amount of power and the process can be carried out by a very simple mechanism.

The process of the invention consists in passing material along an apertured apron or table, preferably inclined, which is made to vibrate rapidly up and down so as to impinge against the under side of the individual pebbles and cause them to bound upward. For that purpose the material of which the apron is made is preferably hard. The very sharp upward vibratory motion of the table causes the harder pebbles of the gravel being treated to bound higher above the table, while the softer and lighter pebbles, including the shale, do not bound so high, but tend to progress along the table closer to its surface. Thus for practical purposes the material passing down the table is separated by the impingements into substantially two strata, of which the lowermost close to the table is composed principally of shale pebbles and the pebbles in the higher stratum or zone are mostly hard.

There is no readily discernable line of demarcation between these two layers, because pieces of intermediate hardness and weight probably occupy an intermediate position between the strata, but the practical result is that separation of the material within commercial limits is produced by the vibration of the apron.

Heretofore it has been customary to subject the mixture of screened pebbles to the action of a crusher or to hammering or impinging action of a beater, whereby the softer pebbles of shale are either crushed to pieces or fractured by impact and are afterwards screened from the hard pieces which remain unbroken.

It will be noted that in the present instance the separation is made without any appreciable breaking of the soft shale pebbles, consequently effecting a considerable saving in power consumption.

A further feature of the invention, carrying out the above mentioned principle of operation, is found in the construction of the apron or table which is made of parallel slats extending crosswise the direction of flow of material along the apron, the slats being arranged in echelon, the up-stream edge of each slat being spaced above the upper face of the preceding slat so as to present ways. Through these ways or slots the soft material, which as above described tends to flow close to the surface of the apron, can readily pass, while the hard pebbles proceed along the apron at a generally higher level than the shale and have less opportunity to escape through the apertures. Consequently they are discharged from the end or discharge station of the apron.

With the foregoing and certain other objects in view, which will appear later in the specification, my invention comprises the devices described and claimed and the equivalents thereof.

In the drawing Fig. 1 is a side view, partly broken away, showing a machine embodying my improvement.

Fig. 2 is an enlarged diagrammatic view of the group of slats forming the apron, the respective

hypothetical layers of shale and of hard pebbles being indicated by dotted lines.

Fig. 3 is an end view of the machine as viewed from the left-hand side in Fig. 1.

Fig. 4 is a sectional detail taken on the line 4—4 of Fig. 1, showing the construction of the apron-vibrating mechanism.

Referring to Fig. 1, the apron A, herein shown as an inclined table, consists of side rails 1 connected by slats 2, 3, preferably made of tool steel or other hard material and extending crosswise the direction of flow down the incline. The material may be supplied in the usual manner at the upper end of the apron from a supply hopper 4. It is to be understood that the material has been screened between desired limits before being fed to the hopper 4.

An energetic up-and-down vibratory movement is imparted to the apron A. A suitable mechanism for producing this motion is illustrated in the drawing and consists of a motor driven pulley 5 mounted on a shaft 6 which is provided with suitable bearings 7. The shaft 6 is formed with an eccentric portion 8 which is journalled in a bearing 9 fixed to the frame 10 in which is mounted the apron A.

The upper edge 2*a* of each metal slat is spaced above the lower edge 3*a* and upper face of the preceding slat, and the opposing faces of the adjacent slats form the top and bottom boundaries of an aperture in the form of a rectangular slot which extends clear across the apron. Each slat is arranged sloping from its up-stream front edge downward to its lower edge diagonally with respect to the side rails 1 of the apron A. The upper edges define a plane, and the lower edges preferably define a second and parallel plane. Thus the material consisting of softer pebbles that do not bound very high and consequently tend to remain close to the apron as they travel down it will run down the downwardly sloping working face of each slat while it is in active vertical vibration and so escape through the slot beneath the edge of the adjacent slat, while the harder material which bounds higher and tends to remain in the air the greater part of the time during its travel down the apron will proceed to the discharge end of the apron.

For purposes of description I have referred to the travel of the slats as an up-and-down vibration, although it is actually a combined up-and-down and forward and back movement.

When the driving mechanism, illustrated in the drawing, is employed, the actual bodily movement of the frame 10 and apron A follows the eccentric 8 in an orbital path. The upward component of this movement causes the slats to strike the pieces a glancing blow that tends to keep the hard stone up in the air, and the back and forth motion has the effect, by reason of edges 2*a* which are presented counter to the general direction of flow along the apron, of retarding the somewhat soft pebbles, and aiding them to more readily escape through the slots while making their way down-stream from the feed end of the apron toward the delivery end.

The manner of mounting the apron A so it can be vibrated by the mechanism of Fig. 4 is illustrated in Figs. 1 and 3, where 11, 11 are rubber blocks secured at their upper ends to the frame 10 of the apron A and at their lower ends to a fixed support, such as a beam 12 of the machine base. These rubber blocks permit the circular motion of the apron above described and prevent the transmission of vibration to the base of the machine.

Referring now to Fig. 2 and to the arrows in Fig. 1, it will be seen that the soft particles tend to travel down the apron in a stratum at a lower level or zone, indicated by letter S, and that the harder pebbles bounding higher tend to travel down the apron in a higher zone, indicated by the letter H. Thus the softer pieces escape downwardly between the slots while the harder pieces travel to the delivery end of the apron.

In practice I have found that the following dimensions, proportions, and speeds of operation of the machine afford satisfactory separation of shale and other undesired materials from gravel.

The material consisted of screened pebbles which would pass through a screen with 2-inch circular openings and pass over a screen with 1¼-inch circular openings, and contained, by weight, fifty per cent hard pebbles and fifty per cent shale or soft pebbles. The slats 2, 3 of hard steel, were ¼-inch thick, 2 inches wide, and 24 inches long and the slots between the inclined slats were ¾-inch wide. The surface of the apron was inclined at an angle of approximately twenty degrees and the face of each slat was at an angle of approximately forty five degrees to the horizontal.

The speed of vibration best suited to this particular material was found to be nine hundred revolutions of the pulley per minute.

After passing over my apron the shale content was reduced from fifty per cent to three per cent, which meets the requirements of current state specifications for material to be used in concrete work.

I have found in practice that any given mixture of hard and soft material screened between any arbitrarily selected size limits can be most effectively handled at one particular speed of vibration and that this speed is best determined by trial, that is to say, the motor speed is to be increased or decreased while the screened material is passing, until the best separation results are attained. Thereafter that speed is to be maintained as closely as is practicable while that material is being handled.

The foregoing description, however, illustrates the operation of the machine on one type of material with the machine working at an appropriate speed and will be sufficient to enable those skilled in the art to change the operation of the machine to suit different materials.

While the claimed method may be carried out in a machine constructed as above described, it can also be accomplished by other known means.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. The method of separating hard stones from softer stones of substantially the same size and shape, which consists of passing the aggregate in a downwardly inclined path along a downwardly inclined apertured table while subjecting the individual pieces of material to blows which are directed upwardly and toward the delivery end of the table at a predetermined angle to the plane of the material and of force and rapidity appropriate to cause the more resilient pieces to be impelled higher above the table than the less resilient pieces and to pass progressively downwardly toward the delivery end of the table; while the less resilient pieces are impelled to a less height and are permitted to escape downwardly through the apertures of the table.

2. The method of separating hard stones from

softer stones of substantially the same size and shape, which consists of moving the material in a downwardly inclined path by individually subjecting the constituent pieces of the aggregate to blows directed upwardly and at an angle toward the lower end of such path, said blows being delivered with force and rapidity appropriate to cause the aggregate to remain mostly up in the air; the harder stones, by reason of their greater resilience, being impelled higher and farther than the soft stones so as to persist in a relatively higher stratum which as a whole moves toward said lower end while the soft stones, by reason of their inferior resilience are impelled to a lesser height and are permitted to escape downwardly away from the upper stratum.

FRANKLIN A. SLATER.