PATENT SPECIFICATION

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(54) A METHOD FOR DIVIDING A MIXTURE OF PIECES OR FRAGMENTS OF DIFFERENT MATERIALS AND DIFFERENT SIZES INTO TWO OR MORE FRACTIONS

(71) We, AZ SELLBERGS AB, a Swedish Company of P.O. Box S-104 32 Stockholm, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method for dividing a mixture of pieces or fragments of different materials and sizes into two or more fractions, the prime intention being not solely to divide the pieces or fragments into fractions of given sizes, but to separate the different types of materials one from the other.

One example of mixtures of different sized pieces or fragments of different materials, the dividing of which mixture into fraction enriched in materials of the same or a similar nature has become of increasing interest in latter times, is fragmented waste materials, and in particular fragmented domestic waste materials. A multiplicity of methods for separating the different materials have been proposed, of which methods wind sieving forms an important step. One such method is that described in U. S. patent specification No 3,524,594. A common feature of all methods based on wind sieving is that the apparatus for carrying out these methods have a relatively low capacity and require much energy.

Swedish patent specification No. 7404856-2 describes a method in which waste is fragmented into two principal fractions which are subsequently separated to form said two main fractions, by means of a sieve having a given mesh size. The coarse fraction will contain mainly fragments of paper and plastics materials, and also some large metal fragments or large fragments of other materials, which must be separated from the coarse fraction in a subsequent separation step. According to one embodiment, it is proposed that the iron fragments are removed magnetically in a separate step prior to sieving the waste.

The present invention consists in a method of dividing into at least two fractions a mixture of pieces of fragments which are of different materials and of different sizes, said method comprising the following steps, namely, driving an inclined shaking table in such a manner that any arbitrarily chosen point on the table will move in a circular orbit in a vertical plane, and charging said mixture onto a region of said table which is at a level which is below that of the centre of the table, whereby some pieces or fragments bounce down the table in a first direction of movement to the lower end of the table to form one of said fractions and other pieces or fragments do not bounce on said table but intermittently engage the surface of the table by friction and are as a consequence fed along the table in a second direction of movement opposite to said first direction of movement to the upper end of the table to form the other or another of said fractions.

A third fraction may be formed by some pieces or fragments passing through the shaking table by way of interstices or apertures in said table which are of sizes corresponding to the largest particle size desired in said third fraction.

The amplitude imparted to the table (diameter of said circular orbit) preferably falls within the range from 40mm to 90mm; in one embodiment said amplitude falls within the sub-range from 45 mm to 80 mm.

The above-described invention, whilst consuming but a small amount of energy, enables fragmented domestic waste, in accordance with one embodiment, to be divided into a fraction containing mainly large fragments of metal, wood, rubber and rigid plastics, a second fraction containing mainly fragments of paper and plastics materials and being free from metal fragments, and a third fraction containing inorganic and organic particles of small particle size. However, it can also be used when separating mixtures of materials other than domestic waste. Two examples in this connection are the separation of metal fragments from plastics, in which case, if so desired, only two fractions need be made, and the treatment of topsoil to remove stones and weeds etc. (in their respective fractions) from the topsoil.

So that the invention will be more readily understood and further features thereof made apparent, exemplary embodiments of the method according to the invention will now be described with reference to the accompanying schematic drawings, in which

Figure 1 illustrates in side view an apparatus for carrying out one embodiment of the method according to the invention, the forward side wall of the apparatus having been removed,

Figure 2 is a plan view of the apparatus shown in Figure 1,

Figure 3 is a perspective view seen obliquely from above of an element of the apparatus shown in Figures 1 and 2,

Figure 4 is a side view of an apparatus for carrying out a further embodiment of the method according to the invention, and

Figure 5 is a plan view of the apparatus shown in Figure 4.

The apparatus illustrated in Figures 1—3 comprises four parallel shaking elements 1 journalled about two crank shafts 2 which, in turn, are journalled in side walls 3. The shaking elements 1 are displaced in relation to each other, as illustrated in Figures 1 and 2, such that when oscillated or rotated by the shafts 2 they will be mutually out of phase. The shafts 2 are located in separate horizontal planes, such that the apparatus will slope. The upper surface of each element 1 exhibits a plurality of sequentially arranged ridges 4 having a gradually sloping side 5 and a side 6 which slopes abruptly towards an imaginary connection between the shafts 2. The upper sides of the ridges carry a metal-wire mesh 7. A plurality of friction elements in the form of transversely extending dogging elements 8 are mounted on the gradually sloping side of the ridges.

As illustrated in Figure 1, a mixture A of fragments of different materials and sizes is charged onto the lower part of the shaking elements 1 whilst the crank shafts 2 rotate clockwise. The elements are thus rotated or oscillated by the crank shafts in a manner such that an arbitrarily selected point on a respective element will move in a circular path. By adjusting the speed at which the crank shafts rotate in a manner such that the vertical movement of the elements exceeds the acceleration at which the mixture freely falls, heavy, rigid and/or elastic fragments, such as pieces of wood, metal, rigid plastics, rubber, will bounce on the gradually sloping sides 5. By adjusting the slope of the sides 5 relative to the horizontal plane, the direction in which said heavy fragments bounce can be adjusted so that said fragments move to the left in the figure, to the extent desired. Thus, as a result of these bouncing movements, these fragments will move towards the lower part (to the left in Figure 1) of the apparatus and gradually leave said lower part to form a first fraction B.

Larger fragments having no, or only slight, rigidity and/or elasticity, such as large fragments of paper and large, thin fragments of plastics in the mixture will fall on a side 5 associated with one of the ridges 4. When this side 5 is lowered from its highest position, as a result of the rotary movement of the element, the speed at which the element moves (see above) is such that the fragments are unable to accompany said element and are left suspended in space to subsequently fall on to said element. Whilst the fragments are falling substantially vertically, the element 1 is able to move to such an extent in its movement path that the fragments will fall on parts of the element 1 which, as seen in the Figure, are located more to the right of the element than that location at which they left the element a moment previously, which parts are then moving upwardly. When these fragments meet the element they do not bounce, and the dogging elements 8 prevent the fragments from sliding along the side 5. When the element, a moment later, moves vertically downwards again in its movement path, whereupon the fragments again part company with said element, the fragments have moved a short distance to the right in the figure, the extent of this distance being dependent upon the speed of rotation and the amplitude of the movement of said element. Consequently, this type of fragment will be conveyed in a direction towards the upper part (to the right in the figure) of the apparatus and will gradually leave the apparatus to form a second fraction C.

A third fraction D comprising small fragments is obtained by causing these fragments to pass straight through the interstices in the mesh 7. When the mixture A comprises fragmented domestic waste, the fraction D may comprise glass, sand, small fragments of paper and plastics material etc.

The apparatus illustrated in Figures 4 and 5 comprises four parallel shaking elements 1 mounted for rotation abut two shafts 2, which in turn are mounted in side walls, the shaking elements being phase-displaced relative to one another and the apparatus being inclined to the horizontal in a manner corresponding to the apparatus illustrated in Figures 1—3. Each element 1 of the apparatus illustrated in Figures 4 and 5, however, is angled at a location 9 to form two parts 10 and 11 in a manner such that the slope of the part 10 from the location 9 to the lower end of the element is greater than the slope of the second part 11. The upper side of each element comprises a perforated plate 12.

As illustrated in Figure 4, a mixture A of fragments of different material and sizes is charged onto a region above the centre of the part 10 of the shaking elements. Owing to the fact that the crank shafts 2 rotate clockwise at a given frequency, there is obtained, in a manner corresponding to the apparatus illustrated in Figures 1—3, a division of the mixture A into three fractions B, C and D, with corresponding respective compositions as with said embodiment.

When the mixture A comprises fragmented domestic waste, the optimum amplitude for movement of the shaking elements is approximately 40 — 90 mm; preferably there is applied an amplitude in the region of 45 — 80 mm. At low amplitudes, it may be necessary to provide the shaking elements with dogging devices in order to obtain an acceptable separation result. Corresponding to each amplitude is an optimum number of revolutions for movement of the shaking elements. The separation efficiency deteriorates relatively quickly on both sides of this optimum speed of revolution, and hence the useful range with regard to speed revolution is generally as narrow as 20 — 30 rpm. The useful rpm range can be best established by varying the speed rotation whilst visually studying the separation with a low flow of material. The optimum speed of rotation can also be adjusted to a satisfactory degree of accuracy in this way.

The angle at which the parts 10 and 11 slope also influences the separation result. A small angle of slope of the part 11 (less than approximately 11° to the horizontal plane) will provide a large second fraction at the upper end of the shaking table, a large part of said fraction containing undesirable material. With respect to the purity of the fractions, the best results have been obtained when the angle at which the part 10 is inclined to the horizontal is between 19 and 23° and the part 11 between 14 — 17°. Preferably, the angles of inclination are 20 — 22° and 15 — 16° respectively. A division into fractions enriched with respect to certain materials is obtained, however, at angles of inclination which lie far beyond these ranges. Large angles of inclination give a better result when using dogging devices.

The method according to the invention can be carried out other than with the illustrated apparatuses; many different types of apparatus can be employed. Thus, the number of shaking elements used may vary from a single element to as many elements as space and practicality will permit. The construction which incorporates ridges 4 in the embodiments shown in Figures 1 — 3 is primarily conditioned by reasons of space, in order to reduce the height of the apparatus. Further, the design of the friction means can be varied to a very large extent. The sizes of the interstices of the mesh 7 and the sizes of the perforations in the perforated plate 12 on the upper side of the elements can be varied, not only as between different apparatuses but also in the longitudinal direction of one end and the tioned. Suitable sizes of interstices or per- same shaking element, as previously men- forations lie within the range of 5 — 30 mm. The wire mesh or perforated plate may also be replaced by, for example, an imperforate plate when no third fraction is required. It is important that the material on the upper side of the shaking elements will provide for a high degree of bounce of those fragments which are to be separated in the first fraction.

Conveniently, the location at which the lower part 10 is angled to the major part 11 (see Figures 4 and 5) is from 15 — 45%, and preferably from 25 — 40%, of the length of the shaking element measured from its lower end. In this respect, said location may be placed further towards the upper limits of these ranges in the case of shorter shaking tables whereas, in the case of longer tables, said location should be nearer the lower limits of said ranges. Suitably, the mixture of pieces or fragments is placed on the table at a point above the centre of the lower part of the table.

This invention is related to the invention which is the subject of Patent Application No. 80 23048 (Serial No. 1 597 444) filed 15th July 1980 which was divided from this Application.

WHAT WE CLAIM IS:—

1. A method of dividing into at least two fractions a mixture of pieces or fragments which are of different materials and of different sizes, said method comprising the following steps, namely, driving an inclined shaking table in such a manner that any arbitrarily chosen point on the table will move in a circular orbit in a vertical plane, and charging said mixture onto a region of said table which is at a level which is below that of the centre of the table, whereby some pieces or fragments bounce down the table in a first direction of movement to the lower end of the table to form one of said fractions and other pieces or fragments do not bounce on said table but intermittently engage the surface of the table by friction and are as a consequence fed along the table in a second direction of movement opposite to said first direction of movement to the upper end of the table to form the other or another of said fractions.

2. A method according to Claim 1, in which a third fraction is formed by some

pieces or fragments passing through the shaking table by way of interstices or apertures in said table which are of sizes corresponding to the largest particle size desired in said third fraction.

3. A method according to Claim 1 or Claim 2, wherein the amplitude imparted to the table (diameter of said circular orbit) falls within the range from 40 mm to 90 mm.

4. A method according to Claim 3, wherein said amplitude falls within the sub-range from 45 mm to 80 mm.

5. A method of dividing into at least two fractions a mixture of pieces or fragments which are of different materials and of different sizes, said method being substantially as hereinbefore described with reference to the accompanying drawings.

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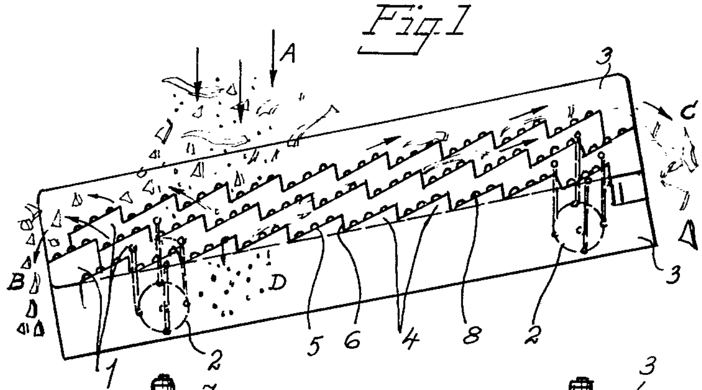
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 1



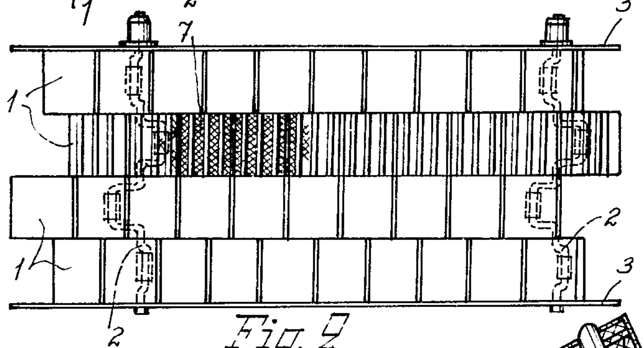
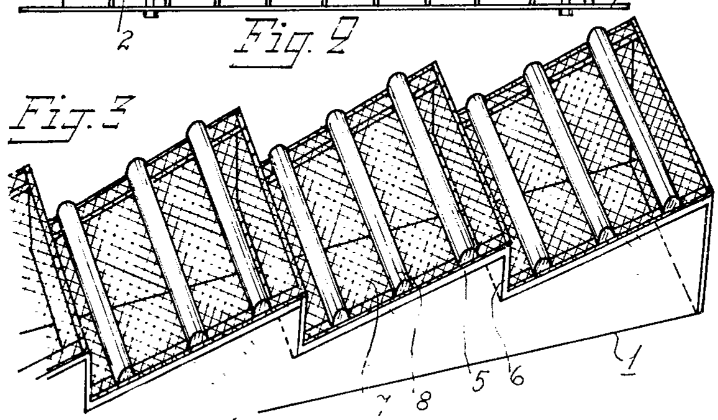


Fig. 2

Fig. 3



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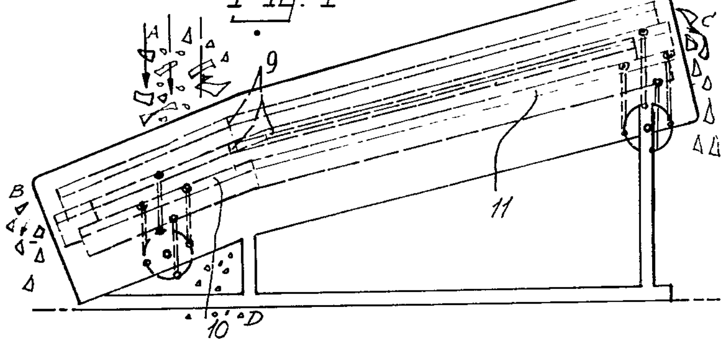
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

Fig. 4



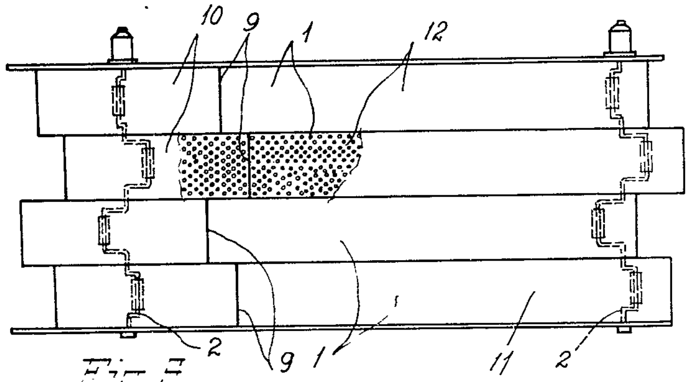


Fig. 5