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Milik

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[54] **MIXING OF PARTICULATE AND FIBROUS MATERIALS**

[75] Inventor: **Rudolf F. L. Milik**, Welwyn Garden City, England

[73] Assignee: **Design Link**, Hertfordshire, England

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[51] **Int. Cl.** **B28c 5/06**

[58] **Field of Search** 259/145, 146, 148, 259/3, 153, 178, 2, 1, 14

[56] **References Cited**

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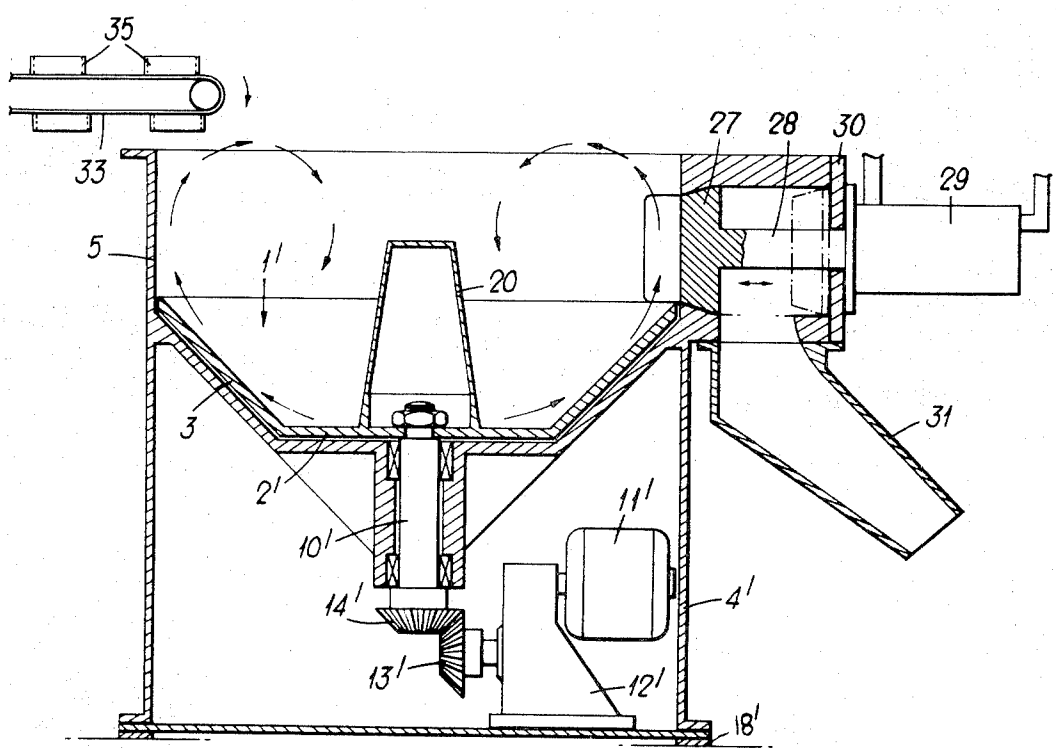
Primary Examiner—Robert W. Jenkins

Attorney—Joseph F. Brisebois et al.

[57] **ABSTRACT**

Two or more materials, at least one of which is fibrous are mixed together by supplying the materials onto a dish-shaped circular surface which is free of projections, closely surrounding the edge of the circular surface with a wall which extends upwards from the surface and rotating the surface with the materials upon it and thus flinging the materials outwards centrifugally and causing them by the dished shape of the surface to be deflected upwards over the face of the wall which slows down the rotation applied to the materials by the rotating surface and directs the materials inwards again towards the centre of the surface whence they are flung centrifugally outwards so that the materials form a toroidally shaped mass around the edge of the surface and the materials circulate around the toroid following a helical path.

5 Claims, 1 Drawing Figure



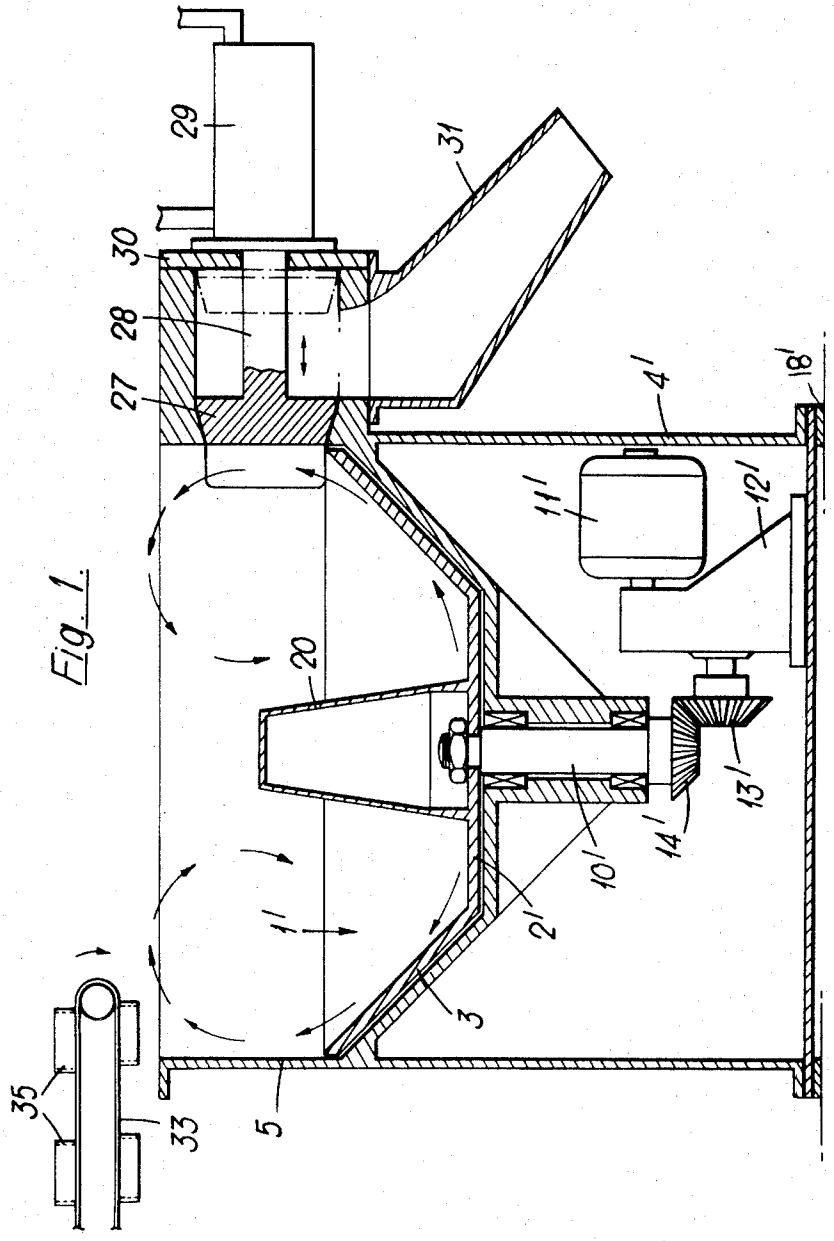


Fig. 1.

MIXING OF PARTICULATE AND FIBROUS MATERIALS

The mixing together of different fibrous materials or the mixing of fibrous materials with other materials such as powders, granulates and liquids has in the past caused very great difficulties because conventional mixers employing rotating blades tend to catch the fibres on the edges of the blades and separate them from the mix thus causing segregation of the fibres from the other constituents of the mixture if any and they also tend to cause inter-twining or balling of the fibres into coagulated lumps. Thus with all conventional forms of mixer it has been found that a homogeneous mixture of two or more fibrous materials or a homogeneous dispersion of fribrous material in other materials is impossible to achieve.

It has now been discovered that by using a form of apparatus which has not previously been used for mixing purposes, two or more different fibrous materials or a fibrous material together with other materials can be mixed together extremely rapidly and efficiently and also in an extremely uniform manner.

Thus, according to the present invention, two or more materials, at least one of which is fibrous are mixed together by supplying the materials to an apparatus comprising a rotary dished platform, which is rotated about a vertical central axis, and a wall which closely surrounds and extends upwards from the rim of the platform, but which does not partake of the rotation of the platform, and then rotating the platform with the materials upon it.

Preferably the surrounding wall is held stationary although it may as an alternative rotate in the same direction as, but much more slowly than, the platform or it may rotate counter to the platform.

With this arrangement the materials to be mixed together are flung outwards centrifugally and owing to the dished shaped of the platform, the materials are forced upwards against the surrounding wall. The contact of the materials with the wall tends to slow down their rotation and to direct the materials inwards again towards the centre of the platform where the materials fall downwards onto the platform and are then flung outwards once again. The result is that the materials tend to form a toroidally shaped mass around the edge of the platform and the materials circulate around the toroid following a helical path. The movement of the materials around this path is of an extremely complex nature and the speed of particle movement of the various materials varies so much that extremely rapid mixing together of the materials results giving rise to a uniform mixture in a matter of only a few seconds.

The form of appartus comprising a rotary dished platform and a surrounding stationary wall is known, but it has in the past only been used for grinding powdered material or for surface finishing metal workpieces which are held in a holder above the platform and have grinding chips circulated over them by rotating the platform.

One embodiment of suitable apparatus is illustrated in the accompanying drawing, in which:

FIG. 1 is an axial sectional view through one specific device suitable for use in carrying out the invention.

The apparatus adapted for mixing purposes preferably includes, in addition to the rotary platform 3 and the surrounding wall 5, conveyors 35 or other means

for supplying the materials to be mixed together to the platform and means for discharging the materials after they have been mixed together. Such an apparatus is described and claimed in our copending Application Ser. No. 216,054, filed Jan. 7, 1972.

Using the method in accordance with the present invention, the two or more fibrous materials can be very uniformly mixed together of a fibrous material can be evenly distributed in other materials and there is no tendency at all for the fibrous material to coagulate into balls or lumps.

We have found that the speed of rotation of the dished platform may vary over quite wide limits, but preferably the speed of rotation is such that the peripheral speed of the platform is about 400 ft. per minute. This corresponds to an angular speed of about 60 revolutions per minute with a platform having a diameter of 2 ft.

Examples of the mixing of fibrous materials with other materials are the mixing of glass fibre staple with powdered plastics materials; the mixing of glass fibre staple in concrete mixes; the mixing of asbestos fibre in cement slurry and the mixing of steel wire staple in concrete mixes.

The method in accordance with the invention has still greater advantages when material with which the fibrous material or materials are to be mixed is of a brittle nature. If a bladed mixer is used, there is a tendency for the brittle constituent of the mixture to be broken up into smaller particles. This is often not desirable. For example, a concrete mix containing glass or other fibre may also contain a brittle aggregate such as a lightweight expanded clay aggregate and the grading of the grain sizes of the aggregate is important to produce a satisfactory mix. It is important therefore once the brittle expanded clay aggregate has been graded that its particles should not be shattered to reduce the grain size during mixing.

Some examples of methods of mixing in accordance with the invention using any one of the pieces of apparatus described and illustrated in our co-pending Application Ser. No. 216,054, filed Jan. 7, 1972, with a platform diameter of 2 ft. and a speed of rotation of 60 revolutions per minute for a time of only a few seconds are as follows:

EXAMPLE I

Pwdered polypropylene, powdered pigment and short glass fibre staple having a fibre length of from 6 mm to 10 mm in percentages by weight of 70 percent, 2 percent and 28 percent respectively were supplied to the platform of the mixer and were mixed for 5 seconds. The resultant mixture had both the powdered pigment and the glass fibre staple uniformly distributed in the polypropylene powder.

EXAMPLE II

Granules or beads of polyethylene to be mixed with asbestos fibres in proportions by weight of 80 percent and 20 percent respectively were supplied to the platform of the machine and were mixed for 5 seconds. The asbestos fibres were found to be uniformly distributed throughout the beads of polyethylene.

EXAMPLE III

Example II was repeated, but using beads of polystyrene in place of the polyethylene. The same result was achieved.

EXAMPLE IV

Staple glass fibres and liquid polyester resin with a hardener added to it was supplied to the platform of the machine in proportions by weight of 90 percent and 10 percent respectively and were mixed for a period of 5 seconds. The glass fibres were found to be uniformly impregnated with the liquid resin.

EXAMPLE V

As a first step in the production of synthetic wood chip board, fibrous wood chips and liquid resin bonding agent with a hardener added were supplied to the platform in amounts of 90 percent and 10 percent by weight and were mixed together for 5 seconds. The fibrous wood chips were found to be uniformly coated and impregnated with the resin ready for moulding into the board.

EXAMPLE VI

Fibrous wood pulp and liquid resin in proportions of 95 percent and 5 percent by weight respectively was supplied to the platform and were mixed together as a preliminary step in the production of paper or cardboard.

EXAMPLE VII

Vegetable fibres together with other vegetable residues were supplied together with a small proportion of powdered vitamin material were supplied to the platform and were mixed together for up to 10 seconds. It was found that the vitamin material was evenly distributed throughout the vegetable matter to form a step in the production of cattle food.

EXAMPLE VIII

A technique for reinforcing concrete by the mixing into the concrete of steel wire staple having a length of about 1 inch has recently been developed, but extreme difficulties have been encountered in the preparation of the mix. For a satisafactory product, it is essential that the steel wire staple should be uniformly distributed throughout the mix, but in practice with known concrete mixers of either the drum or the pan type, the steel wire tends to coagulate into balls and the resultant product is poor.

Sand, stone aggregate, cement, water and steel wire staple of a length of 25 mm and a diameter of 0.30 mm were supplied to the platform in the following respective proportions by weight: 2; 4; 2; 1; 1. The materials were mixed together for 8 seconds and the resultant composition was an extremely satisfactory concrete mix with the steel wire staple uniformly distributed through it.

EXAMPLE IX

Sand, stone aggregate, cement, water and glass fibre in proportions by weight of: 2; 4; 2; 1; 2, respectively were supplied to the platform and were mixed for 8 seconds. The resultant concrete mix was extremely homogeneous and was found to have the glass fibre uniformly distributed throughout.

EXAMPLE X

Cement, water and glass fibre having a fibre length of approximately 1½ inches were supplied to the platform in proportions of 2; 1; 4 by weight and were mixed together for a period of 8 seconds. The resultant fibrous slurry was found to be extremely homogeneous and useful for forming fibre reinforced sheeting or other products somewhat similar to those made from asbestos cement.

EXAMPLE XI

Cement, perlite granules, water, and glass fibre having a fibre length of approximately 1½ inches were supplied to the platform in proportions of 1; 2; 1; 2 by weight and were mixed for approximately 8 seconds. After hardening and the curing, the resultant product had a much lower density than normal concrete containing stone aggregate, but an appreciably higher tensile strength.

EXAMPLE XII

The ingredients of a conventional concrete mix consisting of cement, sand and coarse aggregate in proportions by weight of 1; 2; 4; together with water to give a water/cement ratio of approximately 0.25 and in addition 5 percent by weight of the total mix of polypropylene filament staple were supplied to the platform and were mixed for 10 seconds. After hardening and curing, the resultant concrete had a compressive strength substantially the same as that for an equivalent mix without the polypropylene, but a substantially greater tensile strength.

I claim:

1. A method of mixing together at least two materials, at least one of which is fibrous, said method comprising the steps of supplying said materials to a circular dish-shaped surface, which is substantially free of projections and has its edge surrounded by a wall surface extending upwardly from said edge, and rotating said dish-shaped surface about a vertical central axis and thereby imparting a rotation to said materials and flinging said materials centrifugally outwards and upwards against said wall surface, contact with said wall surface retarding the rotation of said materials and directing said materials inwards towards said axis whence they fall downwards again onto said dish-shaped surface, whereby said materials form a toroidally shaped mass around said dish-shaped surface and said materials circulate along a helical path around said toroidally shaped mass.

2. A method as claimed in claim **1**, further comprising the step of holding said wall surface stationary.

3. A method as claimed in claim **1**, wherein said materials include glass fibre staple and powdered plastics material.

4. A method as claimed in claim **1**, in which said materials include cement, granular aggregate, water and steel wire staple which, after mixing, form concrete.

5. A method as claimed in claim **4**, in which said aggregate includes expanded clay or other brittle material.

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