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(54) **Method for operating an extrusion mill and extrusion mill for use in this method.**

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US-A- 2 160 302
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Description

This invention relates to a method for operating an extrusion mill, in particular a pellet mill, comprising a perforated drum and a number of rollers within the drum, rotatable about their axes and cooperating with the drum to press material to be treated through the perforations in the drum wall, with driving means to have the drum and the axes of the rollers rotate relatively to each other about the axis of the drum, with means to adjust the position of the rollers radially with respect to the drum wall, and to an extrusion mill for use in this method.

Such extrusion mills are often used for making compressed feed in the shape of so-called pellets for feeding cattle or for making pellets for other purposes, by pressing the materials by force through the openings in the drum by the action of the rollers. The strands of material extruded through the openings in the drum can be peeled off by a knife blade along the outer wall of the drum so as to form short cylindrical "rods", the so-called pellets.

Such extrusion mills are known, e.g. from US-A-2.157.528; 2.160.302; 2.240.660 and 2.648.296.

Therein the rollers are adjustable towards and away from the drum wall, sometimes over a short distance, in other cases over a longer distance. In order to adjust the rollers, the mill has to be stopped or at least the extrusion has to be interrupted, e.g. because the mill casing has to be opened for the adjustment. In some cases the rollers are free to move outwardly towards the drum wall by centrifugal force, the adjusting means only defining their radially inward position, but also in such cases the rollers are almost immediately pushed inwardly into said inward position as soon as material to be extruded is fed into the drum.

The present invention is based on the insight that, for many materials to be treated in such mills, this situation is known mills of this type is disadvantageous and avoid or make totally impossible an efficient operation. If the rollers are initially put into a position at a distance from the drum wall they will at first not rotate, but on further feeding of the mill the material fed thereto, which often is tacky, will clog and block the mill entirely. This is also the case when the rollers are free, in an empty mill, to contact the drum wall by centrifugal force.

Depending on the nature of the material to be extruded, the characteristics thereof as to tackiness, viscosity, sliding characteristics on the surface and pressing characteristics it is, in known mills, often necessary to replace the drum by a drum with other, in particular longer or shorter extrusion openings, so with a thicker or thinner wall.

The present invention aims at improving such a method and such a mill in the above respects and to this end first of all a method as indicated above is according to the invention characterized in that at the beginning of the extrusion, the rollers are positioned with their peripheries close to the drum wall and that, during continuing extrusion, the rollers are moved inwardly to take up a distance from the drum wall, by means operable from the outside of the mill.

An extrusion mill, in particular a pellet mill, comprising in known way a perforated drum and a number of rollers within the drum, rotatable about their axes and cooperating with the drum to press material to be treated through the perforations in the drum wall, with driving means to have the drum and the axes of the rollers rotate relatively to each other about the axis of the drum, with means to adjust the position of the rollers radially with respect to the drum wall, is according to the invention characterized in that a rotatable adjusting shaft is provided with its axis in the axis of the drum, and extending to the outside of the mill through a coaxial shaft supporting the rollers, said adjusting shaft having means outside the mill to rotate this shaft, onto which shaft cam means are provided, the axes of the rollers being guided movably by the means carrying the rollers, the cam means cooperating with parts on the axes of the rollers in order to allow or cause movement of these axes radially inwardly when the adjusting shaft with cam means are rotated with respect to these axes.

In this way it is possible, without the necessity to interrupt pressing, to adapt the position of the rollers to the situation at any moment, the amount of adjustment of the rollers in the radial direction at any moment being easily chosen on the basis of experiences, experiments and/or measurements. Such adjustement may take place under control of a computer programmed by such information. Experiences, which may govern such adjustment, may relate to treatment of the same material in the same mill in an earlier stage, from which the best amount of adjustment of the rollers and course of adjustment in time during pressing is known.

Preferably, spring means are provided, acting on the said parts on the axes of the rollers, to urge the said parts radially into contact with the cam means.

In the most preferred embodiment of the mill, this is characterized in that the feed means for material to be extruded, extending through one of the bordering end faces of the mill perpendicularly to the axis of the drum, the adjusting shaft extending through supporting means for the drum at the other side of the drum, said shaft having, outside said supporting means, drive means and means for indicating its angular position and therewith the distance of the rollers to the drum wall.

Thereby the feed side of the drum is fully free for this feed and is not obstructed by the adjusting mechanism, so that it is possible to feed the material to be treated freely from above into the lower part of the drum, as is desired, while said drive means and indi-

cating means are positioned at a distance from the flow of material, so that they for instance are not subjected to the often rather high temperatures in the drum where pressing often takes place in a steam atmosphere.

It is possible to rotate the adjusting shaft by a motor through a suitable gear mechanism, which is shiftable and preferably is a continuously varying transmission gear. The adjusting shaft may easily be provided for instance in a thick hollow hub shaft for rotating the drum and supporting it in cantilever fashion.

When applying the invention a wide range of operating conditions is obtainable by correctly choosing the pattern and the amount of adjustment of the rollers from the drum wall to the inside, and this makes it less necessary to replace the drum frequently for different materials.

The invention will now be explained in more detail with reference to the enclosed drawings.
Therein:

Fig. 1 is an axial section, in part somewhat diagrammatic, of an extrusion mill according to the invention in a preferred embodiment, and

Fig. 2 is an axial view on a larger scale along line II-II in Fig. 1 of the adjusting means near the drum and the rollers, without the drum itself and its casing parts.

An extrusion mill of the type as indicated has a casing 1, in which means are present, not shown, such as an electric motor and a transmission mechanism with gear wheels, chains or V-belts, of which the driven part is rigidly connected to a hub sleeve 2, which is rigidly connected to a cylindrical drum wall 3 having a large number of throughgoing radial openings. By ball-bearings 4 said hub sleeve 2 is journalled on and around a stationery central shaft 5, to which a disk 6 is rigidly connected, having supporting means for three pressing rollers 7, which are freely rotatable with respect to and supported by shafts 8 in a manner generally known.

Around the drum 3 there is a casing 9 connected by pivoting means not shown to casing 1 and locked by locking means opposite said pivoting means so that this casing 9 may be opened and swung away from the drum to give access thereto. The casing 9 serves to shroud the moving parts therein, for sealing them with respect to the ambient atmosphere also at the supply side for the material and for taking up pellets formed therein. A doctoring knife blade not shown can rest against the outside wall of the drum 3 and be urged towards it by resilient means, as usual. As this knife blade is stationery and the drum rotates this knife blade can peel off the extruded strands of material issuing from the openings in the drumm wall and having a considerable coherence, so as to divide them in mainly cylindrical bodies of relatively short length, the so-called pellets.

A feed funnel 10 for feeding the material to be treated is rigidly connected to the end wall of casing 9. At the inside of said end wall there is a substantially annular body 11 extending into close proximity of the left terminal edge of the drum as seen in Fig. 1, said body 11 having blades or other guides 12 to give the material fed thereto a component of movement towards the inside of the drum 3.

The central stationery shaft 5 is hollow in that it has a central throughgoing opening, through which an adjusting shaft 13 extends, which is journalled at 14 at left and right in disk 6 and shaft 5 respectively.

An adjusting motor 15, if desired provided with a suitable speed reducing gear mechanism 16, is provided to rotate the adjusting shaft 13 over part of a revolution, for instance over 100°, in both directions. On shaft 13 a disk 17 is provided with suitable indexing means, cooperating with a feeler 18 for observing the angular position of disk 17 and thus of shaft 13. This observation may be performed in several ways, mechanically or electrically, as usual. The feeler 18 gives a signal to a panel 19 allowing direct reading of the angular position of disk 17 or of an indication, obtained by direct translation thereof, of the distance of the rollers 7 to the inner wall of the drum 3.

In the view of Fig. 2 the stationery disk 6 is seen in the background. Bolts 20 are screwed into this disk and these bolts carry a carrier 21 for the rollers near the left terminal plane of the drum as seen in Fig. 1. At the right of drum 3 as seen in Fig. 1 the disk 6 acts as such a carrier for the rollers.

The disk 6 and the carrier 21 have three radial guide tracks 22 at mutual angles of 120°, with in each of said guide tracks a sliding block 23 with a bearing for the shaft 8 of a roller 7. Compression springs 24, supported onto the radial outer side bottom of each guide track 22, urge the sliding blocks 23 radially inwards.

On the adjusting shaft 13 there is, both at the left and at the right terminal face of the drum 3 as seen in Fig. 1, a cam disk 25 with three cam faces 26, each extending over 120° of the cam disk 25, and each sliding block 23 has a follower body 27 of hard material, by which it is in contact with the outer periphery of the cam disk 25.

By rotating the adjusting shaft 13 the cam disks 25 rotate therewith, so that the radial position of each sliding block 23 is changed by such rotation. The two opposite sliding blocks for each roller 7 are positioned symmetrically and at the same angles in the peripheral direction that the axes 8 of the rollers are always maintained parallel to the wall of the drum 3. By rotating the adjusting shaft it is thus possible to move the rollers 7 towards the drum wall or away therefrom, for instance over a radial distance of 3 cm.

It will be clear that the adjusting mechanism 15 to 18 in Fig. 1 is at a considerable distance from the flow of the material and the moving parts of the drum

and rollers and that this mechanism is in no way hampered operationally thereby. Adjustment of the rollers is always possible without in any way interrupting the operation of the drum. The danger of contamination of the adjusting means is a minimum and the adjustment can take place over relatively considerable distances and can be controlled very accurately, also for very small adjustments.

In Figs 1 and 2 it is shown that the axes 8 of the rollers 7, shown in Fig. 1 as dot and dash-lines and in Fig. 2 as a point, have eccentric shaft trunnions 8', so that when rotating them in the blocks 23 with the aid of the hexagonal heads as shown in Fig. 2 these axes are somewhat displaced with respect to the axes of said trunnions 8'. This serves only for a mutual adjustment of the rollers over a very small radial distance, so that they can be adjusted to be exactly in the same position radially with respect to the drum wall notwithstanding dimensional deviations in the structure.

It is known to measure the coherence of the pellets e.g. by moving a number of them around in a rotating drum and to measure the dust generated. This can be done quite rapidly. If too much dust (particles loosened from the pellets) is measured, the rollers can be adjusted to avoid this in further pressing. Making the rollers move farther inwardly this will result in harder (more coherent) pellets.

Claims

1. Method for operating an extrusion mill, in particular a pellet mill, comprising a perforated drum (3) and a number of rollers (7) within the drum (3), rotatable about their axes (8) and cooperating with the drum (3) to press material to be treated through the perforations in the drum wall, with driving means to have the drum (3) and the axes (8) of the rollers (7) rotate relatively to each other about the axis of the drum (3), with means (20-27) to adjust the position of the rollers (7) radially with respect to the drum wall, characterized in that, at the beginning of the extrusion, the rollers are positioned with their peripheries close to the drum wall and that, during continuing extrusion, the rollers are moved inwardly to take up a distance from the drum wall, by means (15, 16) operable from the outside of the mill.

2. Extrusion mill, in particular a pellet mill, comprising a perforated drum (3) and a number of rollers (7) within the drum (3), rotatable about their axes (8) and cooperating with the drum (3) to press material to be treated through the perforations in the drum wall, with driving means to have the drum (3) and the axes (8) of the rollers (7) rotate relatively to each other about the axis of the drum, with means (20 - 27) to adjust the position of the rollers (7) radially with respect to the drum wall, characterized in that a rotatable adjusting shaft (13) is provided with its axis in the axis of the drum and extending to the outside of the mill through a coaxial shaft (5) for supporting the rollers (7), said adjusting shaft (13) having means (15, 16) outside the mill to rotate this shaft, onto which shaft cam means (25, 26) are provided, the axes (8) of the rollers (7) being guided movably by the means (6, 21) carrying the rollers, the cam means (25, 26) cooperating with parts (27) on the axes (8) of the rollers (7) in order to allow or cause movement of these axes (8) radially inwardly when the adjusting shaft (13) with cam means (25, 26) are rotated with respect to these axes (8).

3. Extrusion mill according to claim 2, in which spring means (24) are provided on the carrying means (21) for the rollers to keep the said parts (27) on the axes (8) of the rollers (7), cooperating with the cam means (25, 26), in contact therewith.

4. Extrusion mill according to claim 2 or 3, in which the drum (3) has feed means (10-12) for material to be extruded, extending through one of the bordering end faces of the mill perpendicularly to the axis of the drum, the adjusting shaft (13) extending through supporting means (5, 6) for the drum (3) at the other side of the drum (3), said shaft (13) having, outside said supporting means (5,6), drive means (15, 16) and means (17-19) for indicating its angular position and therewith the distance of the rollers (7) to the drum wall.

Patentansprüche

1. Verfahren zum Betätigen einer Extrusionsmühle, insbesondere einer Pelletiermühle, mit einer perforierten Trommel (3) und einer Anzahl von Rollen (7) innerhalb der Trommel (3), die um ihre Achsen (8) drehbar sind und mit der Trommel (3) zusammenwirken um zu behandelndes Material durch die Perforationen in der Trommelwand zu pressen, mit einer Antriebseinrichtung, um die Trommel (3) und die Achsen (8) der Rollen (7) relativ zueinander um die Achse der Trommel (3) drehen zu lassen, mit Mitteln (20 - 27), um die Lage der Rollen (7) radial in bezug auf die Trommelwand einzustellen, dadurch **gekennzeichnet**, daß zu Beginn der Extrusion die Rollen mit ihrem Außenumfang nahe der Trommelwand angeordnet sind, und daß während die Extrusion fortgesetzt wird, die Rollen durch von außerhalb der Mühle betätigbare Mittel (15, 16) einwärts bewegt werden, damit sie einen Abstand von der

Trommelwand einnehmen.

2. Extrusionsmühle, insbesondere Pelletiermühle, mit einer perforierten Trommel (3) und einer Anzahl von Rollen (7) innerhalb der Trommel (3), die um ihre Achsen (8) drehbar sind und mit der Trommel (3) zusammenwirken um zu behandelndes Material durch die Perforationen der Trommelwand zu pressen, mit Antriebsmitteln um die Trommel (3) und die Achsen (8) der Rollen (7) relativ zueinander um die Achse der Trommel drehen zu lassen, mit Mitteln (20, 27) um die Lage der Rollen (7) radial in bezug auf die Trommelwand einzustellen, dadurch **gekennzeichnet**, daß eine drehbare Einstellwelle (13) mit einer mit der Trommelachse übereinstimmenden Achse vorgesehen ist, die sich durch eine die Rollen lagernde Koaxialwelle (5) hindurch zur Außenseite der Mühle erstreckt, wobei die Einstellwelle (13) außerhalb der Mühle Mittel (15, 16) aufweist, um diese Welle zu drehen, wobei auf dieser Welle Nockenscheiben (25, 26) vorgesehen sind, die Achsen (8) der Rollen (7) durch eine Trageinheit (6, 21) für die Rollen beweglich geführt sind, die Nockenscheiben (25, 26) mit Teilen (27) auf den Achsen (8) der Rollen (7) zusammenwirken, um eine Bewegung der Achsen (8) radial einwärts zu ermöglichen oder zu verursachen, wenn die Einstellwelle (13) mit den Nockenscheiben (25, 26) in bezug auf diese Achsen (8) gedreht wird.

3. Extrusionsmühle nach Anspruch 2, bei der Federmittel (24) auf der Trageinheit (21) für die Rollen vorgesehen sind, um die Teile (27) auf den Achsen (8) der Rollen (7), die mit den Nockenscheiben (25, 26) zusammenwirken, mit diesen in Kontakt zu halten.

4. Extrusionsmühle nach Anspruch 2 oder 3, bei der die Trommel (3) eine Zuführeinrichtung (10 - 12) für das zu extrudierende Material hat, die sich durch eine der begrenzenden Endstirnseiten der Mühle senkrecht zur Trommelachse erstreckt, die Einstellwelle (13) sich durch eine Stützeinrichtung (5, 6) für die Trommel (3) auf der anderen Seite der Trommel (3) erstreckt, die Welle (13) außerhalb der Stützeinrichtung (5, 6) Antriebsmittel (15, 16) und Anzeigemittel (17 - 19) für ihre Winkelstellung und damit die Entfernung der Rollen (7) von der Trommelwand aufweist.

Revendications

1. Procédé pour faire fonctionner un moulin d'extrusion, en particulier un moulin à granules comportant un tambour perforé (3) et un certain nombre de cylindres (7) à l'intérieur du tambour (3) pouvant tourner autour de leurs axes (6) et coopérant avec le tambour (3) pour comprimer un matériau à traiter à travers les perforations dans la paroi du tambour, avec un dispositif d'entraînement pour permettre au tambour (3) et aux axes (8) des cylindres (7) de tourner relativement les uns par rapport aux autres autour de l'axe du tambour (3), avec des moyens (20-27) pour régler la position des cylindres (7) radialement par rapport à la paroi du tambour, caractérisée en ce que, au début de l'extrusion, les cylindres sont positionnés avec leur périphérie au voisinage immédiat de la paroi du tambour et en ce que, pendant que l'extrusion se poursuit, les cylindres sont déplacés vers l'intérieur pour prendre une certaine distance à partir de la paroi de tambour, par des moyens (15, 16) pouvant être actionnés à partir de l'extérieur du moulin.

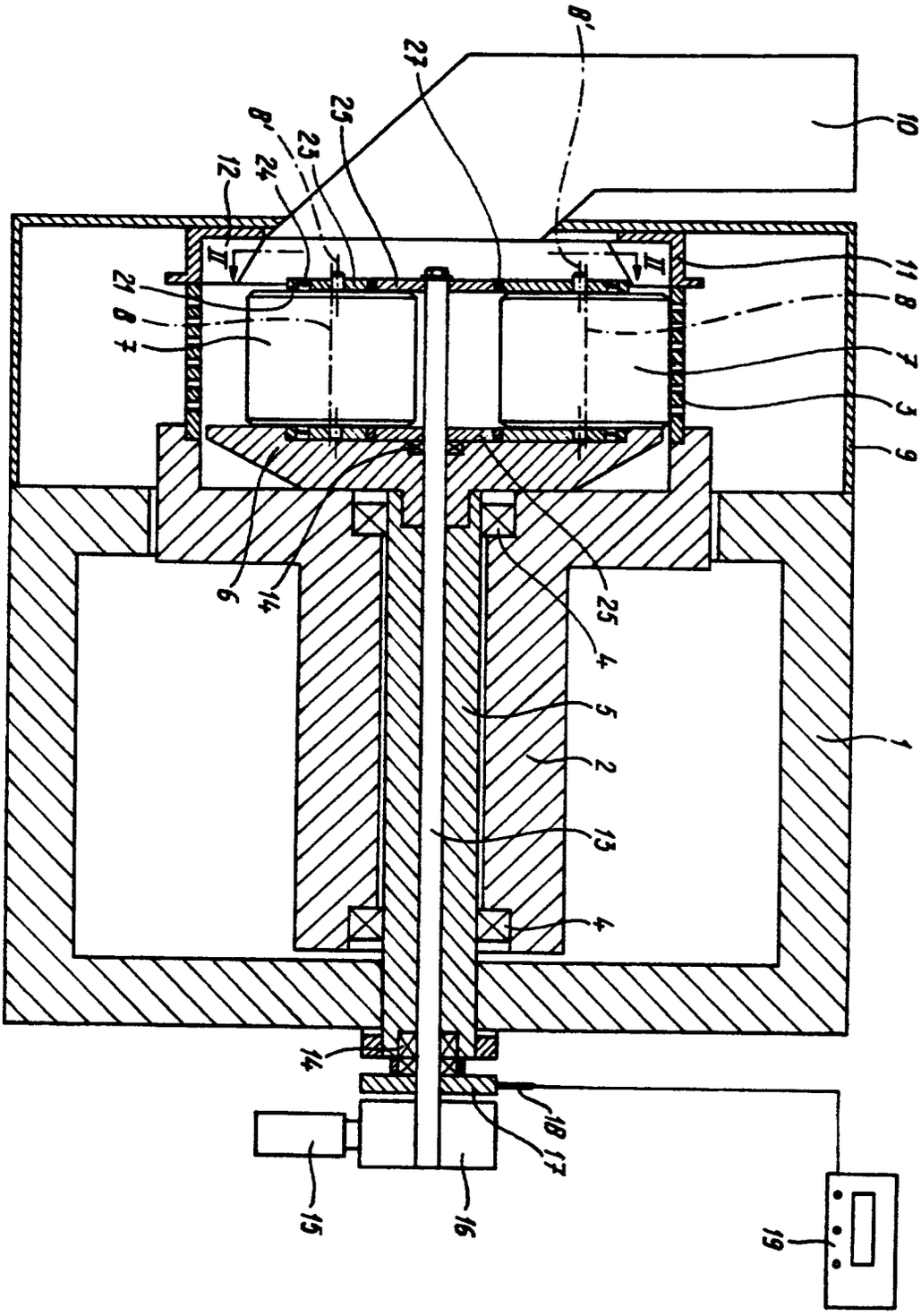
2. Moulin d'extrusion, en particulier un moulin pour granules, comportant un tambour perforé (3) et un certain nombre de cylindres (7) à l'intérieur du tambour (3), pouvant tourner autour de leurs axes (8), et coopérant avec le tambour (3) pour comprimer un matériau à traiter à travers les perforations de la paroi du tambour avec un dispositif d'entraînement pour permettre au tambour (3) et aux axes (8) des cylindres (7) de tourner relativement les uns par rapport aux autres autour de l'axe du tambour avec des moyens (20, 27) pour régler la position des cylindres (7) radialement par rapport à la paroi de tambour, caractérisé en ce qu'un arbre rotatif de réglage (13) est prévu avec son axe dans l'axe du tambour et qui s'étend à l'extérieur du moulin au travers d'un arbre coaxial (5) pour supporter les cylindres (7), ledit arbre de réglage (13) ayant des moyens (15, 16) se prolongeant à l'extérieur du moulin pour faire tourner cet arbre, sur lequel des moyens de came (25, 26) sont prévus, les axes (8) des cylindres (7) étant guidés de manière mobile par les moyens (6, 21) portant les cylindres, les moyens de came (25, 26) coopérant avec des éléments (27) sur les axes (8) des cylindres (7 afin de permettre ou de provoquer le déplacement de ces axes (8) radialement vers l'intérieur lorsque l'arbre de réglage (13) avec les moyens de came (25, 26) sont entraînés en rotation par rapport à ces axes (8).

3. Moulin d'extrusion selon la revendication 2, dans lequel des moyens élastiques (34) sont prévus sur les moyens de support (21) des cylindres pour maintenir lesdits éléments (27) sur les axes (8) des cylindres (7), coopérant avec les moyens de came (25, 26), en contact avec eux.

4. Moulin d'extrusion selon la revendication 2 ou 3, dans lequel le tambour (3) comporte des moyens

d'alimentation (10, 12) pour un matériau à extruder, se prolongeant à travers l'une des faces terminales limitrophes du moulin perpendiculairement à l'axe du tambour, l'arbre de réglage (13) s'étendant à travers les moyens de support (5, 6) du tambour (3) de l'autre côté du tambour (3), ledit arbre (13) présentant, à l'extérieur desdits moyens de support (5, 6), des moyens d'entraînement (15, 16) et des moyens (17, 19) pour indiquer sa position angulaire et conjointement la distance des rouleaux (7) à la paroi du tambour.

Fig - 1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