PATENT SPECIFICATION (11) 1315853

1315853

DRAWINGS ATTACHED

(21) Application No. 6911/70 (22) Filed 12 Feb. 1970
(23) Complete Specification filed 14 Jan. 1971
(44) Complete Specification published 2 May 1973
(51) International Classification B65B 69/00
(52) Index at acceptance
B8C 10B1B 10B1D1 10B1D3 10P1C 10P1D 7A

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(19)

(54) MACHINE FOR OPENING AND EMPTYING BAGS CONTAINING FIBROUS MATERIALS

(71) We, TAC CONSTRUCTION MATERIALS LIMITED (formerly Turners Asbestos Cement Company Limited) a British Company of Asbestos House, Fountain Street, Manchester, Lancashire, 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:—

Asbestos fibres are nearly always transported packed in bags. This is necessary to enable the fibres to be held somewhat compressed as otherwise their bulk for a given weight is excessive. Similar considerations apply to other fibrous materials of comparatively low density such as raw wool or kapok.

It has been usual in the past for these bags to be opened and emptied manually and for this purpose the bags are slit across one end and are then shaken vigorously with the opened end lowermost. However this manual opening is time consuming and therefore expensive and, particularly in the case of asbestos fibres, the dust which is produced may constitute a health hazard to the workers opening and emptying the bags.

It is very desirable therefore to be able to open and empty bags mechanically. Existing machines for carrying out this operation, however, act by cutting the bag approximately centrally around a part of its periphery whilst the two ends of the bag are held and the two ends of the bag are then twisted at an angle to each other to form an open slit and the bag is then mechanically shapen. It has been found that these machines operate quite well with bags containing granular material or other material which will flow evenly from the slit in the bag, but with asbestos fibres or other fibres of a flocculent cohesive nature, the results are not satisfactory. With asbestos in particular, the contents do not fall out of the slit, but remain so firm as to make effective shaking impossible, and with other material it is found that a substantial amount of the material remains sticking to the inside of the bag and this is wasted.

The aim of the present invention is to provide a machine which is capable of removing fibrous material such as asbestos fibres or other flocculent cohesive material from bags in an efficient manner so that to all intents and purposes all of the material is removed.

To this end, according to this invention, such a machine comprises a support for supporting a bag of the material in a lying position in engagement with a cutter, a mechanism for moving the bag and the cutter relatively to each other to cut the bag along one end and along the adjacent sides, or along one end, one adjacent side and the other end, and a stripping device which grips the part of the bag below the cut and strips it away from its contents and in so doing moves the bag and its contents towards the edge of a separating partition which is adjacent the stripping device so that the stripped bag passes on one side of the partition.

In this way by making a relatively long slit around two sides and one end, or two ends and one side of the bag and drawing the bag away from the contents rather than emptying the contents from the bag, it has been found that the separation between the bag and the contents can be extremely effective.

Preferably the support for the bag is in the form of a platform on which the bag moves towards the stripping device and is slit during its movement. The trailing end of the bag remains unslit and the stripping device then draws the bottom part of the bag below the slit onwards in its direction of movement downwards closely past a substantially horizontal edge of the separating partition which slopes downwards from this edge. The bag is then drawn onwards by the stripping device below the edge of the partition and the contents of the bag is pushed by the remaining part of the bag at the unslit trailing end and the part of the bag above the slit over the

[Price 25p]

top of the partition before this part of the bag is itself dragged down by the stripping device below the partition.

The platform on which the bag is supported may be horizontal and in this case it may consist of a series of power driven rollers for conveying the bag to the stripping device, but preferably the platform is inclined downwards towards the stripping device and consists of freely rotatable conveyor rollers over which the bag is moved by gravity.

The stripping device may consist of a power-driven spiked roller, the spikes of which pierce the part of the bag below the slit and draw it away from its contents as the roller rotates. Rotation of the roller takes place in a direction which assists the passage of the bag on its supporting platform past the cutter and onwards to the edge of the separating partition which is arranged in a position spaced around the periphery of the spiked roller from the platform which forms the support for the bag.

With a support in the form of a power driven or gravity roller conveyor, the bag moves relatively to the cutter as its sides are slit, but preferably the cutter is also mounted so that it moves to make the initial slit across the leading end of the bag. For this purpose the cutter may comprise a pair of rotary knives each of which is mounted on the end of an arm which is pivoted about an upright axis to enable the knife to swing along a substantially horizontally disposed arc of movement which extends across the path of the bag from its platform or other support towards the stripping device.

Preferably the knives are swung by a mechanism which is arranged so that initially one rotary knife is disposed directly in the path of movement of the bag so that it forms a slit in the end of the bag as the bag moves towards it. The two knives are then swung with each other across the path of movement of the bag so that the first knife extends its slit to one side of the bag and the second knife makes a slit from the other side of the bag extending towards and intersecting the slit made by the first knife. To ensure that the two slits made by the two rotary knives across the end of the bag intersect each other, the planes of action of the rotary knives are preferably slightly inclined out of the horizontal in opposite directions to each other.

Preferably after the knives have been swung laterally to slit the end of the bag, they are swung apart from each other until they are separated by a distance somewhat less than the width of the bag between its two sides. As the bag then passes from its platform towards the stripping device and then onwards to the separating partition, the two knives extend their slits from the leading end of the bag along its two sides and leave the trailing end unslit.

To enable the machine to accommodate bags of different widths and slit their sides without the rotary knives penetrating too deeply into the bag contents, the distance apart by which the knives are set after they have slit the leading end of the bag is preferably automatically adjustable in dependence upon the width of the bag. For this purpose feelers are provided for sensing the width of the bag and these feelers control the mechanism by which the knives are swung apart from each other to limit the movement apart in dependence upon the width of the bag which has been sensed.

The feelers are preferably formed by clamping pads which move in laterally and grip the sides of the bag between them when the bag moves on the support into contact with the first rotary knife. These clamping pads therefore perform the double function of sensing the width of the bag and also holding the bag while the two rotary knives make their slits across its leading end. After this the clamping pads move apart from each other to allow the bag to move on its platform consisting of power driven or gravity rollers onwards towards the stripping device while the knives slit the sides of the bag.

To enable the clamping pads to set the positions of the rotary knives for slitting the sides of the bags, the clamping pads are connected to a stop which is set in a position dependent upon the position in which the clamping pads move inwards to hold the bag. This stop operates a limit switch on the mechanism which swings the knives and stops the swinging movement when the knives are at a distance apart which is dependent upon the position of the stop and thus also dependent on the width of the bag as determined by the distance between the clamping pads.

An example of a machine constructed in accordance with the invention is illustrated somewhat diagrammatically in the accompanying drawings, in which:—

Figure 1 is a plan;

Figure 2 is a section as seen in the direction of the arrows on the line II—II in Figure 1;

Figure 3 is a section as seen in the direction of the arrows on the line III—III in Figure 2; and,

Figure 4 is a perspective view of a bag showing the slits cut in it by the machine.

The machine has an outer metal casing 1 which in addition to forming an enclosure for most of the working parts of the machine, also forms a chassis supporting the various parts of the mechanism. At the left-hand side of the casing 1 as seen in Figure 2, there is a bag support in the form of a hoist platform 2. The hoist platform is movable upwards and downwards between the raised position shown in full lines in Figure 2 and a lowered position shown in chain-dotted lines at 2'. The platform 2 carries a series of freely rotatable

conveyor rollers 3 which form its supporting face. The platform is carried by guide rollers 4 which run in guides which are fixed to the sides of the casing 1 and one of which is indicated in chain-dotted lines at 5. The platform 2 is raised and lowered by a cable 6 which is wound up and unwound by a hoist 7 which is fixed to a top plate 8 of the casing 1 by a bracket 9.

When the platform 2 is in its lowered position shown at 2', it is at the same level as a roller table 10 which is mounted just outside the casing 1. Above the table 10, the casing 1 has an inlet opening 11 and, in use, a bag containing asbestos fibres or other flocculent cohesive material is placed on the table 10 and is then pushed manually onto the platform 2 when this is in its lowered position. After this the platform 2 is raised by the cable 6 and as the guide rollers 4 pass around the bend in the guide 5 as shown in Figure 2, the platform 2 tilts into the position shown in full lines in Figure 2.

A pair of clamping pads 10' are mounted on each of two side plates 11' of the casing 1 and these clamping pads are movable towards and away from each other. To enable the pads 10' to be moved towards and away from each other, their outer ends are pivotally connected to levers 12 and 13 which are fixed to shafts 14. The shafts 14 are rotatable in bearings 15 which are fixed to projecting parts 16 of the housing 1 and in further bearings 17 carried by brackets 18.

The levers 13 terminate at the shafts 14, but the levers 12 have second arms 19 and 20 which extend upwards above the shafts 14. The upper end of the arm 19 is pivotally connected by a connecting rod 21 to the upper end of a two-armed lever 22 which is pivotally mounted on a bracket 23. The arm 20 is pivotally connected by a connecting rod 24 to the bottom end of the lever 22 and the connecting rod 24 extends past the end of the lever 22 and is pivotally connected to a piston rod 25 of a pneumatic ram 26. The right-hand end, as seen in Figure 3, of the cylinder of the pneumatic ram 26 is pivotally attached to the arm 19 and the left-hand end of the cylinder carries a bracket 27 which supports a microswitch with an operating member 28.

When the pneumatic ram 26 is extended, the levers 12 and 13 on the right-hand side of the machine as shown in Figure 3 rock in a clockwise direction and the levers 12 and 13 on the left-hand side of the machine rock in a counterclockwise direction, the geometry of the linkages being such that the clamping pads 10' on the two sides of the casing 1 are moved in by equal distances. The pads move in until they meet the bag on the platform 2 and then when a predetermined resistance to the movement is reached, movement ceases. As the lever 12 on the right-hand side of the machine turns, the cylinder of the pneumatic ram 26 moves towards the right and in consequence the operating member 28 of the microswitch also moves to the right and ends up in a position which is dependent upon the width of the bag.

A bag cutter is formed by a pair of rotary knives 29 and 30 which are carried on the shafts of their own individual electric driving motors 31 and 32 respectively. The motors 31 and 32 are mounted on arms 33 and 34 respectively and these arms are fixed to upright shafts 35 and 36 which are rotatably mounted in bearing brackets 37 and 38 fixed to the top of the casing 1.

Levers 39 and 40 are fixed to the tops of the shafts 35 and 36 respectively and carry at their ends cam follower rollers which engage in cam grooves 41 and 42 in a rotary cam drum 43.

In use, the rotary cam drum 43 is turned by a driving motor which is not shown and as the cam follower rollers on the ends of the levers 39 and 40 follow their grooves, the levers 39 and 40 are swung backwards and forwards and the arms 33 and 34 move with them so that the rotary knives 29 and 30 are also swung to and fro. The microswitch which has the operating member 28 is connected in a control circuit of the motor which rotates the cam drum 43 and the lever 39 has a second arm 44 which, as the rotary knife 29 is swung outwards comes into contact with the operating member 28 and opens the switch thus stopping the motor which drives the cam drum 43 and stopping the swing of the knives 29 and 30 at a distance apart which is dependent upon the position in which the operating member 28 is set and this in turn is dependent upon the positions of the clamping pads 10' and the width of the bag which is clamped between the pads 10.

Aligned with the supporting surface formed by the rollers 3 when the hoist platform 2 is in its raised position are further freely rotatable conveyor rollers 45 supported by the sides of the casing 1. On the side of the rollers 45 remote from the platform 2 is a stripping device in the form of a rotary spiked roller 46 which is driven by an electric motor which is not shown. On the side of the spiked roller 46 remote from the rollers 45 and the platform 2 is an inclined partition 47 which has its upper edge 48 very close to the tips of the spikes on the roller 46. The partition 47 leads downwards to a space 49 formed between one face of the casing 1 and a wall 50. A rotary toothed wheel 51, which is driven by the same motor as the spiked roller 46 is provided in the top of the space 49, that is at the bottom of the inclined partition 47.

To the left of the wall 50 as seen in Figure 2, there is a further space within the casing 1 and this is bounded on its left-hand side by another wall 52. The casing 1 has an open-

ing in one side leading to this space so that a truck 53 can be wheeled into it. The upper end of the wall 52 has a bracket 54 supporting a doctor comb 55 which engages with the surface of the spiked roller 46.

In operation, as already described, a bag containing for example asbestos fibres, is placed on the table 10 is then pushed onto the platform 2 which is then raised and tilted as already described. While this happens, the cam drum 43 has been rotated to a position such that the rotary knives 29 and 30 occupy the positions shown in Figure 1 of the drawings. The knives themselves are already rotating.

As the platform 2 tilts, the bag runs down the rollers 3 until its leading end engages with the knife 29 and is slit. The forward movement of the bag on the rollers 3 and thence on the rollers 45 is arrested by a freely rotating wheel 56 which is mounted on the shaft of the motor 31 coaxially with the knife 29. The wheel 56 thus limits the penetration of the knife 29. The knife 30 is provided with a similar freely rotatable wheel which is not shown.

When the bag is arrested by the wheel 56, the pneumatic ram 26 is operated to move the clamping pads 10' inwards. These hold the bag and since their inward movement is stopped by the bag in the manner already described, they also act as feelers for sensing the width of the bag and set the operating member 28, which forms a stop, in a position which is dependent upon the bag width.

At this stage, the motor which rotates the cam drum 43 is started and the rotary knife 29 swings outwards in a clockwise direction as seen in Figure 1. This causes it to make a cut 57 across the end of the bag 58 as shown in Figure 4. At the same time the knife 30 is swung inwards to form a cut 59 across the remainder of the end of the bag 58. The knives 29 and 30 are slightly inclined so that the cuts 57 and 59 are similarly inclined and this ensures that the cuts intersect each other so that the end face of the bag 58 is severed into two parts.

As rotation of the cam drum 43 continues, the knife 29 is swung outwards until the arm 44 strikes the operating member 28 and stops the motor driving the cam drum. During this rotation, the knife 30 has been swung outwards again and it stops in a position which is symmetrical to the position of the knife 29, but on the other side of the centre line of the bag.

The clamping pads 10' are then released and the bag is moved by gravity further downwards along the conveyor rollers 3 and 45 so that the knives 29 and 30 start to make slits 60 and 61 respectively in the sides of the bag 58. After the bag has moved a short distance, its underside below the cuts 57 and 59 is impaled on the spikes of the roller 46 and this helps to move the bag forwards between the knives 29 and 30 so that the cutting of the slits 60 and 61 is completed. The part of the bag below the slits is dragged around on the spiked roller 46 until it is stripped from the spikes by the doctor comb 55. Thus the stripped bag passes underneath the edge 48 of the partition 47. The asbestos fibre in the bag, however, passes over the top of the edge 48 of the partition 47 and slides down this partition towards the toothed wheel 51 which breaks up any cohesive lumps of fibre and the fibre falls into the space 49. The bottom of the space 49 is provided with a conveyor belt or other means by which the asbestos fibre is removed through an opening in the casing 1.

Since the part of the bag 58 below the slits 57, 59, 60 and 61 remains joined to the part of the bag above the slits at the trailing end of the bag, the part of the bag above the slits is also dragged down by the spiked roller 46 below the partition 47 and when the bag has been entirely stripped from the spiked roller 46 by the doctor comb 55 it falls into the truck 53.

As soon as the trailing end of the bag has left the rollers 3 and is supported entirely on the rollers 45, the hoist platform 2 is lowered into the position shown at 2' ready to receive the next bag which is at once raised on the platform 2. During this time the cam drum 43 is rotated further to return the knives 29 and 30 to their starting positions.

The wheels 56 are preferably made of aluminium or other low density material to reduce their angular momentum as far as possible so that they can be quickly stopped by the contact of the bag with them and in this way wearing a way of the bag by the wheel is prevented and the penetration of the rotary knife into the bag is reliably controlled.

Preferably, particularly in the case of a machine for removing asbestos fibre from bags, where there is a health hazard, the casing 1 is connected to a suction fan by which the pressure within the casing is reduced and dust from the fibre is drawn away. Since during the time that the fibre is in motion it is always within parts of the machine surrounded by the casing 1, the escape of any asbestos dust into the atmosphere is prevented.

WHAT WE CLAIM IS:—

1. A machine for removing a fibrous material from bags, the machine comprising a support for supporting a bag of the material in a lying position in engagement with a cutter, a mechanism for moving the bag and the cutter relatively to each other to cut the bag along one end and along the adjacent sides, or along one end, one adjacent side and the other end, and a stripping device which grips the part of the bag below the cut and strips it

away from its contents and in so doing moves the bag and its contents towards the edge of a separating partition which is adjacent the stripping device so that the stripped bag passes on one side of the partition and the contents pass on the other side of the partition.

2. A machine according to claim 1, in which the support is a platform on which the bag moves towards the stripping device and is slit by the cutter during its movement, the trailing end of the bag remaining unslit and the stripping device being arranged to draw the bottom part of the bag below the slit onwards in its direction of movement and downwards closely below a substantially horizontal edge of the partition which slopes downwards from this edge.

3. A machine according to claim 2 in which the platform includes a series of freely rotatable conveyor rollers and the platform is inclined downwards towards the stripping device so that the bag is moved towards the stripping device by gravity.

4. A machine according to claim 2 or claim 3 in which the stripping device comprises a power-driven spiked roller the spikes of which are arranged to pierce the part of the bag below the slit and draw it away from its contents as the roller rotates and rotation of the roller taking place in a direction which assists the passage of the bag on its platform past the cutter to the partition.

5. A machine according to any one of the preceding claims in which the cutter comprises a pair of rotary knives each of which is mounted on an arm which is pivoted about an upright axis to enable the knife to swin along a substantially horizontally disposed arc of movement which extends across the path of movement of the bag from the support towards the stripping device.

6. A machine according to claim 5 in which the knives are swung by a mechanism which operates so that initially one rotary knife is disposed directly in the path of movement of the bag so that this knife forms a slit in the end of the bag as the bag moves towards it, the two knives are then swung with each other across the path of movement of the bag so that the first knife extends its slit to one side of the bag and the second knife makes a slit from the other side of the bag extending towards and intersecting the slit made by the first knife.

7. A machine according to claim 6 in which the mechanism operates in such a way that after the knives have been swung across the path of movement of the bag to slit the end of the bag, they are swung apart from each other so that the bag passes between them and the knives extend their slits from the leading end of the bag along its two sides and leave the trailing end of the bag unslit.

8. A machine according to claim 7 in which feelers are provided for sensing the width of the bag and these feelers control the mechanism by which the knives are swung to limit the movement of the knives apart from each other in dependence upon the width of the bag which has been sensed.

9. A machine according to claim 8, in which the feelers are formed by clamping pads which are moved laterally inwards and grip the sides of the bag between them to hold the bag while its leading end is slit.

10. A machine according to claim 9 in which the clamping pads are connected to a stop which is set in a position dependent upon the position into which the clamping pads move inwards to grip the bag, the stop operating a limit switch on the mechanism which swings the knives and stops this swinging movement when the knives are at a distance apart which is dependent upon the position of the stop and thus also dependent on the width of the bag as determined by the distance between the clamping pads.

11. A machine according to any one of claims 5 to 10, in which the planes in which the rotary knives are swung are slightly inclined out of the horizontal in opposite directions to ensure that the slits made by the knives across the end of the bag intersect each other.

12. A machine according to any one of claims 5 to 11, in which each rotary knife has a driving shaft on which a wheel is freely rotatably mounted, the wheel limiting the penetration of the knife into the bag.

13. A machine according to any one of claims 5 to 12 in which the knives are swung by cam followers on the ends of levers, the cam followers engaging in grooves in a rotary cam drum.

14. A machine according to claim 9 or claim 10, or claim 11, or claim 12 or claim 13 when dependent upon claim 9 or claim 10, in which the clamping pads are interconnected through two-armed levers and connecting rods and are movable towards and away from each other by a fluid pressure-operated ram acting on one of the levers.

15. A machine according to claim 4, or any one of claims 5 to 14 when dependent upon claim 4, in which there is a doctor comb engaging with the periphery of the spiked roller for stripping the bags from the spikes.

16. A machine according to claim 2, or any one of claims 3 to 15 when dependent upon claim 2, in which a rotary toothed wheel is provided at the bottom of the partition for breaking up cohesive lumps of fibre as the fibre falls from the partition.

17. A machine according to any one of the preceding claims which has a surrounding casing connected to a suction fan which is

arranged to reduce the pressure within the casing and draw away any dust there may be in the material from the bags.

18. A machine according to claim 1 constructed and arranged to operate substantially as described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1973.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.