

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) METHOD AND APPARATUS FOR MOULDING SHEETS

(71) We, JAMES HARDIE & COY. PTY. LIMITED, a company incorporated under the Laws of the State of New South Wales, Commonwealth of Australia, of "Asbestos House", Corner York and Barracks Streets, Sydney, New South Wales, Commonwealth of Australia, 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:—

This invention relates to a method and apparatus for the moulding of articles from a green sheet of hard setting material.

In the production of asbestos cement articles such as non-planar wall and roof cladding sheets, architectural mouldings and the like, it is customary to produce a pliable, so called "green", asbestos cement sheet, to shape the green sheet by placing it upon or in a mould and pressing it into conformity with the mould surface and to cure the shaped sheet to produce a finished article.

Hitherto the shaping of the green sheet has been effected by hand trowelling it against the mould surface. As a result the production of asbestos cement moulded sheet articles has been laborious, time-consuming and, therefore expensive.

The present invention was devised to eliminate much of the manual work from the production of asbestos cement moulded sheet articles.

According to one aspect of the invention it consists in sheet moulding apparatus comprising a mould, a conveyor adapted to support and move said mould, at least one pressure pad disposed above said conveyor and power means to reciprocate said pad, or pads, such that when the machine is in use the pad, or each pad if there be more than one, is brought into repeated pressure contact with a green hard setting sheet on said mould to cause said sheet to conform to the shape of said mould, said pressure pad, or each of them, comprises a plurality of closely spaced, downwardly extending, pliable fingers of rubber or other elastic

material; it being the tips of said fingers which contact said sheet.

Because of their close spacing the fingers provide mutual support one for another but, even so, the closely spaced finger tips constitute a resilient surface adapted to conform to a wide variety of mould shapes while pressing the green asbestos cement sheet into contact therewith.

The invention, according to another aspect, consists in a method of moulding an article from a green sheet of hard setting material comprising the steps of laying the sheet upon a mould, passing said mould with the sheet on it below at least one pressure pad and causing said pressure pad, or pads, to rise and fall repetitively so as to bring the pad, or pads, into repeated pressure contact with said sheet; the dimensions of the pressure pad or pads, and when there is more than one pad, the spacing between them in the direction of motion of the mould, the frequency of the rise and fall of the pad or pads, and the speed of the mould being selected such that every part of the surface of the sheet is contacted at least once by the pad or by at least one pad, if there be more than one present.

For preference, a pliable separator sheet (or sheets) is (or are) interposed between the pressure pad, or pads, and the green sheet of hard-setting material as the latter passes under the pressure pad or pads.

Such a separator sheet produces a better result, presumably because it diffuses or spreads the force applied by the pads to the green sheet.

When the preferred form of pressure pad is used the surface of the separator sheet or sheets presented to the pad is preferably smooth, with a low co-efficient of friction, so permitting individual finger-tips to slide so that individual fingers deflect by bending rather than by buckling.

To that end the separator sheet may comprise a single sheet of plastics material or the like. Alternatively, two or more separator

sheets may be used of which only the upper one is a smooth plastics sheet and the other, or others, may be canvas or other tough but pliable material.

5 For preference, the smooth upper surface of the separator sheet may be wet with water, or otherwise lubricated, to reduce the friction between it and the pressure pads still further.

10 By way of example, an embodiment of a moulding machine in accordance with the invention is described in more detail hereinafter with reference to the accompanying drawings.

15 Figure 1 is a side elevation of a sheet moulding apparatus according to the invention.

Figure 2 is a plan view of the apparatus of Fig. 1.

Figure 3 is an end elevation of the apparatus on line 3—3 of Figure 2.

20 Figure 4 is a side elevation taken on line 4—4 of Figure 2.

Figure 5 is an enlarged sectional view taken on line 5—5 of Figure 4.

25 Figure 6 is a sectional view taken on line 6—6 of Figure 5.

Figure 7 is a side elevation of a pressure pad and its supporting structure, being a component of the apparatus of Figure 1 drawn to a larger scale than that Figure.

30 Figure 8 is an end elevation of the pressure pad and supporting structure of Figure 7.

The mould conveyor of the illustrated embodiment of the invention is an endless chain type comprising a supporting frame 10, a horizontal head shaft 11 at one end of the frame 10, a horizontal tail shaft 12 at the other end of the frame 10, a plurality of endless conveyor chains 13 disposed side by side and each riding about associated head and tail pulleys 14 and 15 respectively on the respective shafts 11 and 12 and conveyor driving means 16 for the rotation of the head shaft 11. The chains 13 are spaced apart laterally and are tied together by timber bars 17 spanning the array of chains 13 and bolted or otherwise secured to the chains 13.

45 The conveyor driving means 16 comprise a conveyor motor 16A, drive connected by means of pulleys 18 and transmission belt 19 to a variable speed gear box 20 which is directly connected to a reduction box 21 with its output shaft coupled to shaft 11.

50 The timber bars 17 are closely spaced in the direction of motion of the chains 13 and thus the bars 17 in the upper flight at any instant constitute a moving platform for the support and carriage of a mould.

55 The conveyor supporting frame 10 includes two slotted tables 22 extending laterally of the conveyor and spaced apart in the longitudinal direction of the conveyor. The arrangement is such that the upper flight travels over the tables 22 with the bars 17 sliding on them, and the chains 13 travelling freely through the slots in the table surfaces. Thus the bars 17 are

firmly supported as they travel over the tables 22.

An arched frame comprising two side supporting structures 23 and 24 respectively and a horizontal bridge beam 25 spans the conveyor with the bridge beam 25 disposed above the gap between the tables 22.

Two rock lever fulcrum shafts 26 and 27 extend from one said supporting structure to the other.

75 The two fulcrum shafts 26 and 27 are spaced one above the other and each has a plurality of rock levers 28 and 29 respectively secured to it. For preference, the two arms of each rock lever 28 or 29 are equal, that is to say, the fulcrum shaft for each lever extends through the centre point of the lever.

80 Each fulcrum shaft 26 or 27 carries the same number of rock levers 28 or 29 as the case may be and the levers are disposed in pairs in that the levers 29 on the lower fulcrum shaft 27 are situated directly below the levers 28 on the upper fulcrum shaft 26 respectively.

85 The free ends of each pair of rock levers 28 and 29 are interconnected by parallel links 30. Thus, the two levers 28 and 29 of each pair and the links 30 connecting the lever ends constitute a four link parallel linkage mechanism such that rotary oscillation of one or other fulcrum shaft 26 or 27 causes the links 30 to reciprocate in a substantially vertical although slightly arcuate path with the links on opposite sides of the fulcrum shafts 180° out of phase; that is to say, when the links 30 on one side are at the bottom point of their travel the links 30 on the other side are at the top point of their travel and vice versa.

90 In the embodiment of the invention now being described there are four pairs of rock levers 28 and 29, and, thus, four links 30 on each side of the arched frame.

95 The arched frame side structure 23 carries a short crank shaft 31 extending horizontally through the side structure 23 in a direction parallel to the fulcrum shafts 26 and 27.

100 The inner end of the crank shaft 31 has a crank arm 34 on it connected by a connecting rod 33 to a crank arm 32 on the fulcrum shaft 27. The dimensions of the two crank arms 34 and 32 are such that rotation of the crank shaft 34 causes rotary oscillation of the fulcrum shaft 27.

105 Such rotary motion may be effected by means of a main drive motor 35 connected by a main drive belt to a pulley 37 on the crankshaft 31.

110 A beam-like pressure pad backing element 38 spanning the conveyor is fixed to the bottom ends of the four links 30 on each side of the arched frame so that each backing element 38 reciprocates in a substantially vertical direction.

115 A pressure pad 39 is secured to the underface of each backing element 38.

Each pressure pad 39 may comprise a rubber moulding comprising a plurality of closely spaced fingers 40 extending downwardly from a backing sheet 41.

From the foregoing it will be apparent that a mould placed upon the top flight of the conveyor will be caused to pass under the pressure pads 39 which may, therefore, come into repeated pressure contact with a green asbestos cement sheet on the mould if an appropriate spacing between the upper surface of the conveyor and the lower surface of the pressure pads 39 at the lower extremity of their travel is provided.

For preference, the aforesaid spacing may be adjusted and, to that end, the arched frame side structures 23 and 24 are preferably each in two parts, namely, a base part 42 (to which the conveyor frame, and tables 22 may be fixed) and an upper part 43 able to be raised and lowered relative to the base part 42. It is, of course, the two upper parts 43 of the side structures which carry the bridge beam 25, the fulcrum shafts 26 and 27 and the crank shaft 31.

Both the base part 42 and the upper part 43 of each side structure may be fabricated from mild steel plate. Each base part 42 may be in the nature of a hollow box 44 (Figures 5 and 6) and the bottom of each upper part 43 may comprise two downwardly projecting cheek plates 45 between which the hollow box-like base 44 is a sliding fit.

The cheek plates 45 are carried by cross-heads 46 which extend through the base part 42 and are movable upwardly and downwardly in guide slots in the side walls thereof.

Each side construction includes two said cross-heads 46 spaced apart in the direction of conveyor travel to provide a stable support for the upper parts 43 of the arched frame.

Each cross-head 46 may itself be supported by a heavy compression spring 47 housed within the base part against a screw adjustable stop or jack 48 within the upper portion of the base part 42 above the cross-head 46. For preference, the four screw adjustable stops or jacks 48 are connected together by driving chains 49 extending from each of them to sprockets on a common, manually rotatable lay shaft 50 whereby concerted adjustment of all four stops or jacks 48 may be effected simultaneously thereby raising or lowering the upper parts of the aforesaid arched frame.

The preparation of the mould for the receipt of the green asbestos cement sheet and the final curing and removal of the formed sheet from the mould may be of a conventional nature.

60 WHAT WE CLAIM IS :—

1. A method of moulding an article from a green sheet of hard-setting material comprising the steps of laying the sheet upon a mould, passing said mould with the sheet on it below

at least one pressure pad and causing said pressure pad, or pads, to rise and fall repetitively so as to bring the pad, or pads, into repeated pressure contact with said sheet: the dimensions of the pressure pad, or pads, and when there is more than one pad, the spacing between them in the direction of the motion of the mould: the frequency of the rise or fall of the pad, or pads; and the speed of the mould, being selected so that every part of the surface of the sheet is contacted at least once by the pad or by at least one pad if there be more than one present.

2. A method according to Claim 1 including the step of covering said green sheet with a separator sheet or sheets before passing the green sheet under the pressure pad or pads.

3. A method according to Claim 2, wherein said separator sheet or sheets presents a smooth surface to the pressure pad or pads.

4. A method according to either Claim 1 or Claim 2 including the step of lubricating that surface of the separator sheet or sheets which is exposed to the pad or pads.

5. Apparatus for effecting the method of Claim 1 comprising a mould, a conveyor adapted to support and move said mould, at least one pressure pad disposed above said conveyor and power means to reciprocate said pad, or pads, such that when the machine is in use the pad, or each pad, if there be more than one, comes into repeated pressure contact with a green, hard-setting sheet on said mould to cause said sheet to conform to the shape of said mould, said pressure pad, or each of them, comprising a plurality of closely spaced, downwardly extending pliable fingers of rubber or other elastomeric material; it being the tips of said fingers which contact said sheet.

6. Apparatus according to Claim 5, where-
crum shafts extending from one side supported above said conveyor by means comprising two side supporting structures disposed one on either side of the conveyor, two rock lever fulcrum shafts extending from one side supporting structure to the other and disposed one above the other, a plurality of rock levers fixed to each fulcrum shaft with the rock levers of the upper shaft disposed respectively above the rock levers of the lower shaft, and a plurality of parallel links interconnecting the free ends of each pair of rock levers in the one vertical plane to the lower ends of which links the pressure pads are secured.

7. Apparatus according to Claim 6, wherein said power means comprise a main driving motor, a crank shaft driven by said motor, a crank arm projecting radially from one of said fulcrum shafts and a connecting rod extending from said crank arm to said crank shaft.

8. Apparatus according to Claim 6 or Claim 7, wherein said side structures are extensible to permit adjustment of the spacing between said pressure pads and said conveyor.

Each pressure pad 39 may comprise a rubber moulding comprising a plurality of closely spaced fingers 40 extending downwardly from a backing sheet 41.

From the foregoing it will be apparent that a mould placed upon the top flight of the conveyor will be caused to pass under the pressure pads 39 which may, therefore, come into repeated pressure contact with a green asbestos cement sheet on the mould if an appropriate spacing between the upper surface of the conveyor and the lower surface of the pressure pads 39 at the lower extremity of their travel is provided.

For preference, the aforesaid spacing may be adjusted and, to that end, the arched frame side structures 23 and 24 are preferably each in two parts, namely, a base part 42 (to which the conveyor frame, and tables 22 may be fixed) and an upper part 43 able to be raised and lowered relative to the base part 42. It is, of course, the two upper parts 43 of the side structures which carry the bridge beam 25, the fulcrum shafts 26 and 27 and the crank shaft 31.

Both the base part 42 and the upper part 43 of each side structure may be fabricated from mild steel plate. Each base part 42 may be in the nature of a hollow box 44 (Figures 5 and 6) and the bottom of each upper part 43 may comprise two downwardly projecting cheek plates 45 between which the hollow box-like base 44 is a sliding fit.

The cheek plates 45 are carried by cross-heads 46 which extend through the base part 42 and are movable upwardly and downwardly in guide slots in the side walls thereof.

Each side construction includes two said cross-heads 46 spaced apart in the direction of conveyor travel to provide a stable support for the upper parts 43 of the arched frame.

Each cross-head 46 may itself be supported by a heavy compression spring 47 housed within the base part against a screw adjustable stop or jack 48 within the upper portion of the base part 42 above the cross-head 46. For preference, the four screw adjustable stops or jacks 48 are connected together by driving chains 49 extending from each of them to sprockets on a common, manually rotatable lay shaft 50 whereby concerted adjustment of all four stops or jacks 48 may be effected simultaneously thereby raising or lowering the upper parts of the aforesaid arched frame.

The preparation of the mould for the receipt of the green asbestos cement sheet and the final curing and removal of the formed sheet from the mould may be of a conventional nature.

WHAT WE CLAIM IS :—

1. A method of moulding an article from a green sheet of hard-setting material comprising the steps of laying the sheet upon a mould, passing said mould with the sheet on it below

at least one pressure pad and causing said pressure pad, or pads, to rise and fall repetitively so as to bring the pad, or pads, into repeated pressure contact with said sheet: the dimensions of the pressure pad, or pads, and when there is more than one pad, the spacing between them in the direction of the motion of the mould: the frequency of the rise or fall of the pad, or pads; and the speed of the mould, being selected so that every part of the surface of the sheet is contacted at least once by the pad or by at least one pad if there be more than one present.

2. A method according to Claim 1 including the step of covering said green sheet with a separator sheet or sheets before passing the green sheet under the pressure pad or pads.

3. A method according to Claim 2, wherein said separator sheet or sheets presents a smooth surface to the pressure pad or pads.

4. A method according to either Claim 1 or Claim 2 including the step of lubricating that surface of the separator sheet or sheets which is exposed to the pad or pads.

5. Apparatus for effecting the method of Claim 1 comprising a mould, a conveyor adapted to support and move said mould, at least one pressure pad disposed above said conveyor and power means to reciprocate said pad, or pads, such that when the machine is in use the pad, or each pad, if there be more than one, comes into repeated pressure contact with a green, hard-setting sheet on said mould to cause said sheet to conform to the shape of said mould, said pressure pad, or each of them, comprising a plurality of closely spaced, downwardly extending pliable fingers of rubber or other elastomeric material; it being the tips of said fingers which contact said sheet.

6. Apparatus according to Claim 5, wherein shafts extending from one side supported above said conveyor by means comprising two side supporting structures disposed one on either side of the conveyor, two rock lever fulcrum shafts extending from one side supporting structure to the other and disposed one above the other, a plurality of rock levers fixed to each fulcrum shaft with the rock levers of the upper shaft disposed respectively above the rock levers of the lower shaft, and a plurality of parallel links interconnecting the free ends of each pair of rock levers in the one vertical plane to the lower ends of which links the pressure pads are secured.

7. Apparatus according to Claim 6, wherein said power means comprise a main driving motor, a crank shaft driven by said motor, a crank arm projecting radially from one of said fulcrum shafts and a connecting rod extending from said crank arm to said crank shaft.

8. Apparatus according to Claim 6 or Claim 7, wherein said side structures are extensible to permit adjustment of the spacing between said pressure pads and said conveyor.



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9. Sheet moulding apparatus substantially as described herein with reference to the accompanying drawings.

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